FIG.1

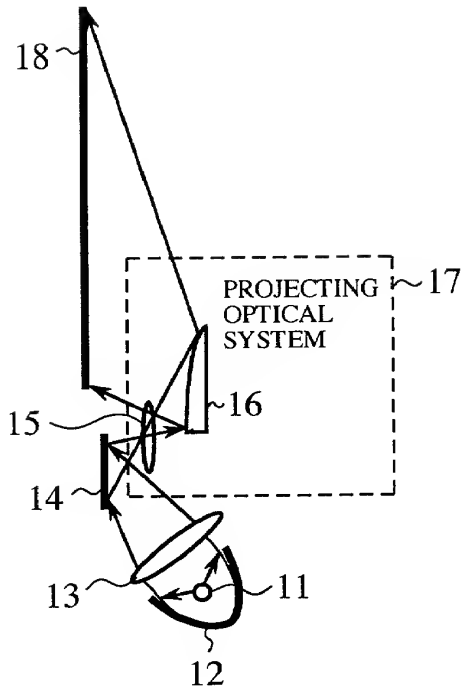
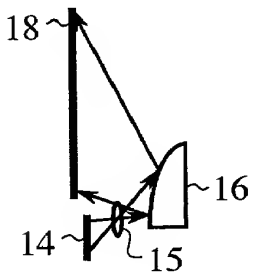

18
PROJECTING
OPTICAL
SYSTEM
17
16
15
14
13
11
12

FIG.2


18
16
14
15

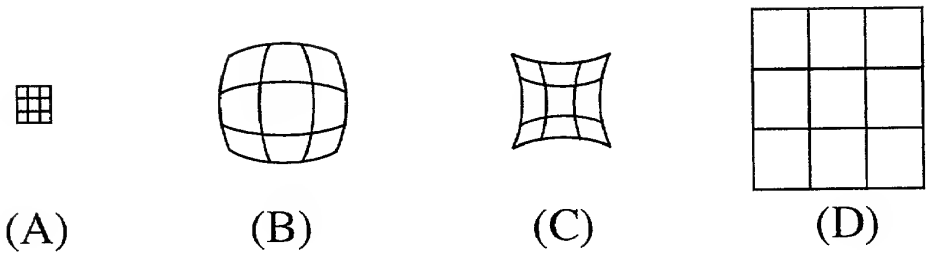

(A)
(B)
(C)
(D)

FIG.3

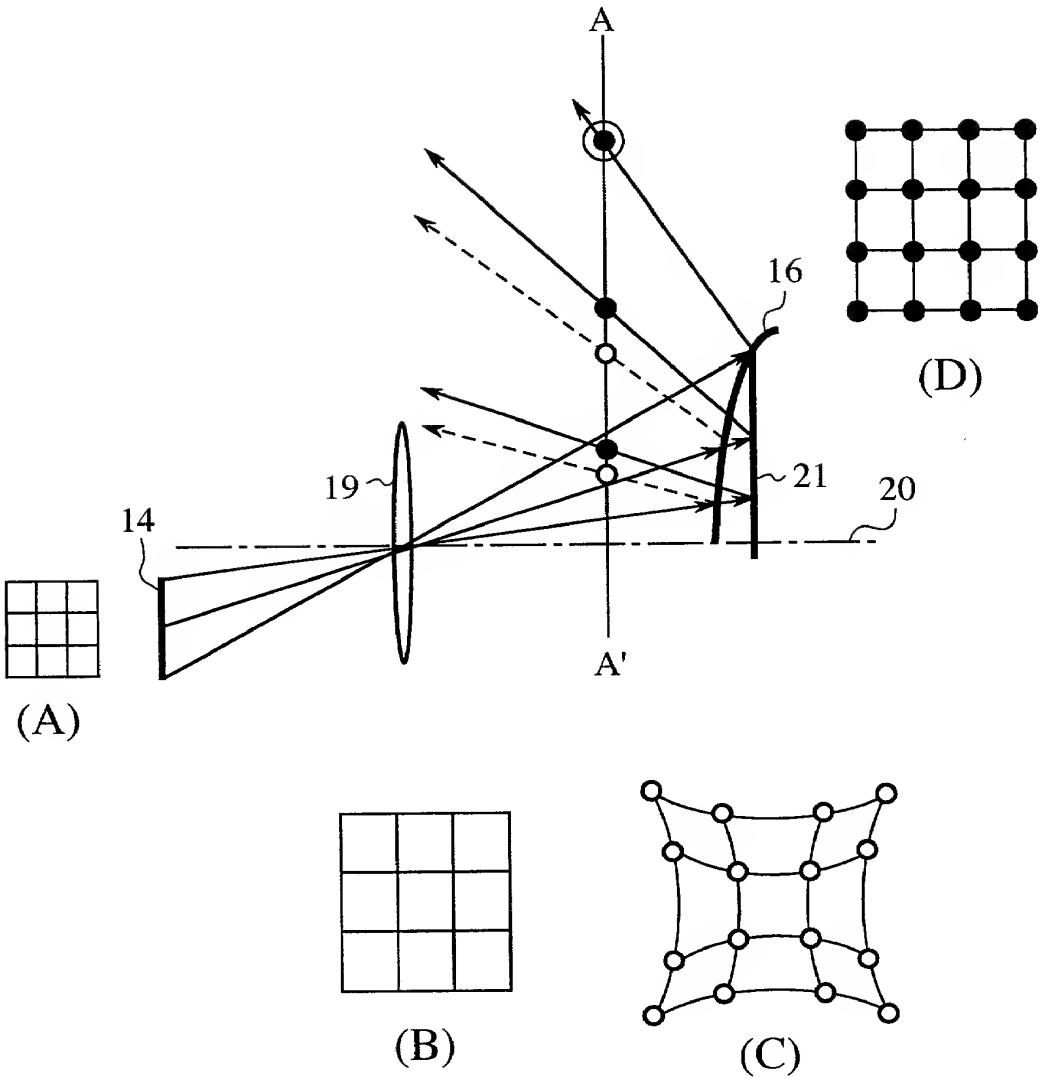


FIG.4

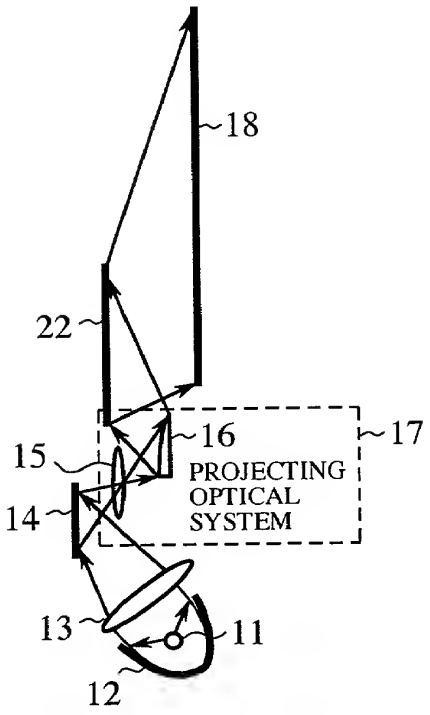

18
22
16
17
15
PROJECTING
OPTICAL
SYSTEM
14
13
11
12

FIG.5

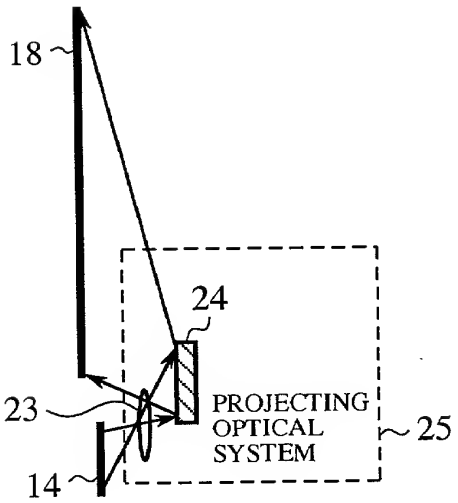

18
24
23
PROJECTING
OPTICAL
SYSTEM
25
14

FIG.6

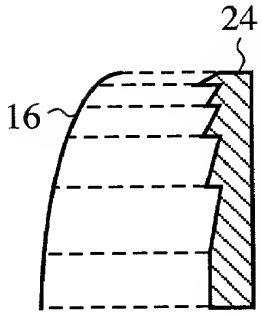


FIG.7

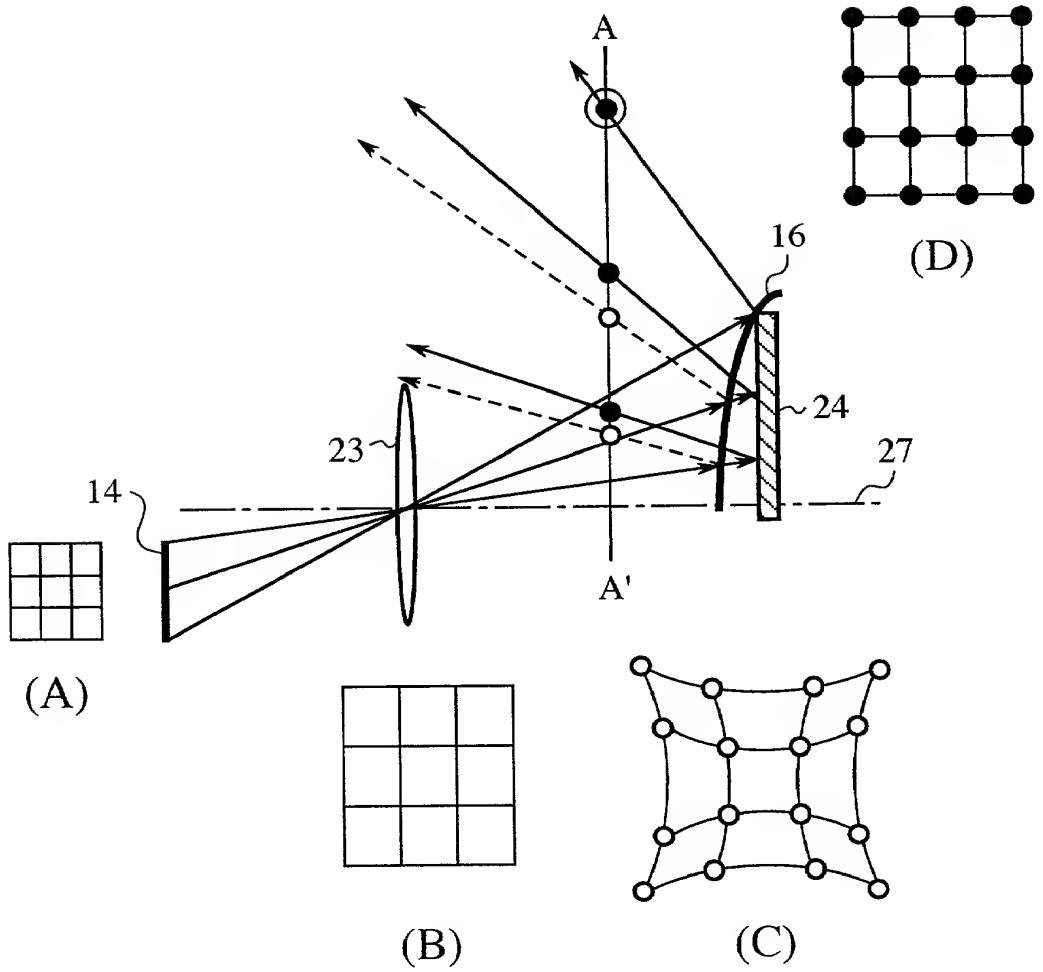


FIG.8

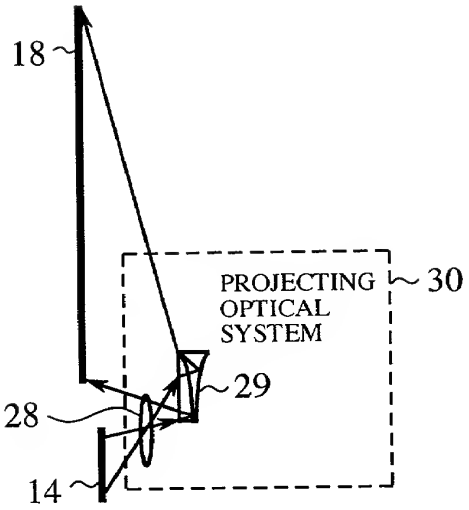


FIG.9

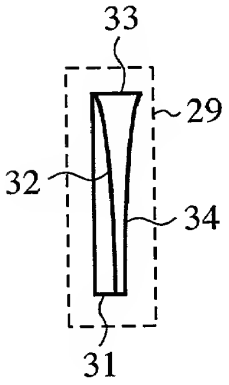


FIG.10

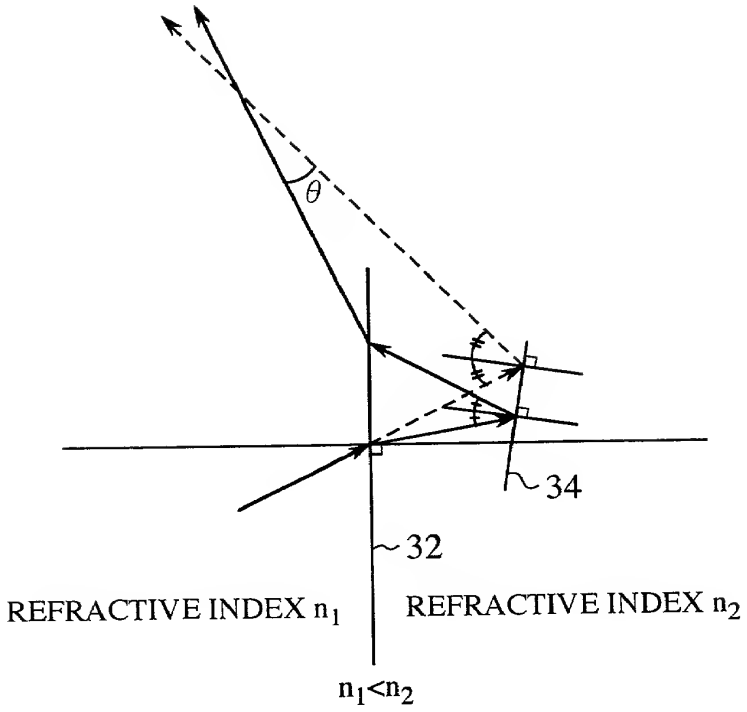

θ
34
32
REFRACTIVE INDEX n_1
REFRACTIVE INDEX n_2
$n_1<n_2$

FIG.11

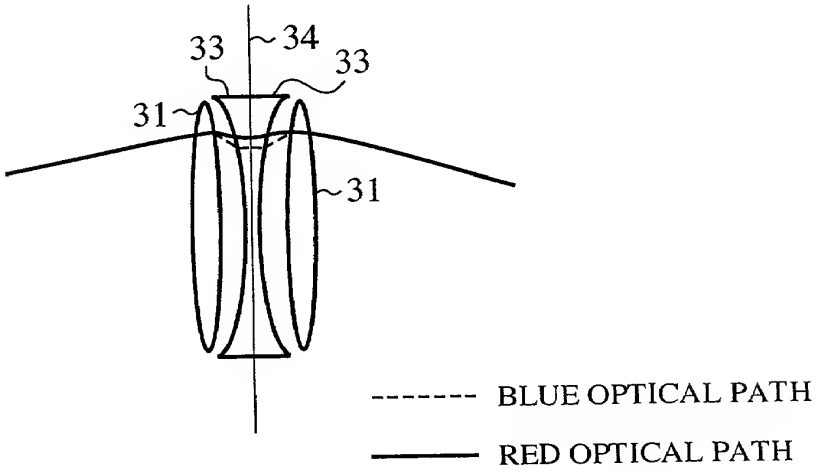

33
34
33
31
31
------- BLUE OPTICAL PATH
——— RED OPTICAL PATH

FIG.12

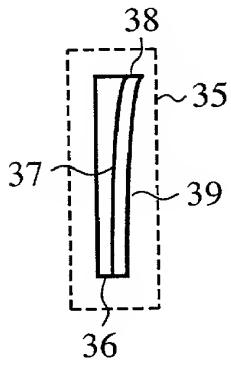


FIG.13A

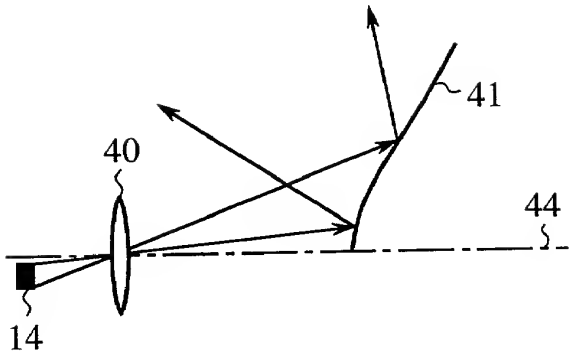


FIG.13B

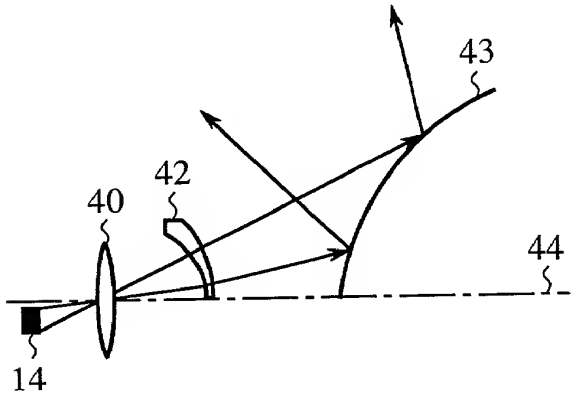


FIG.13C

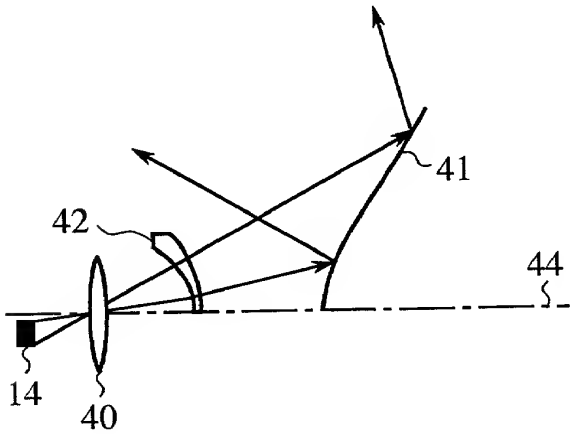


FIG.14

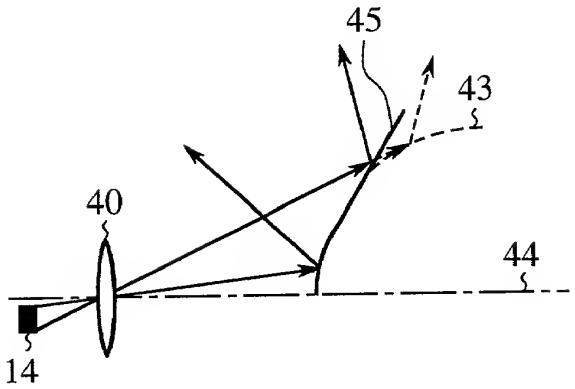


FIG.15

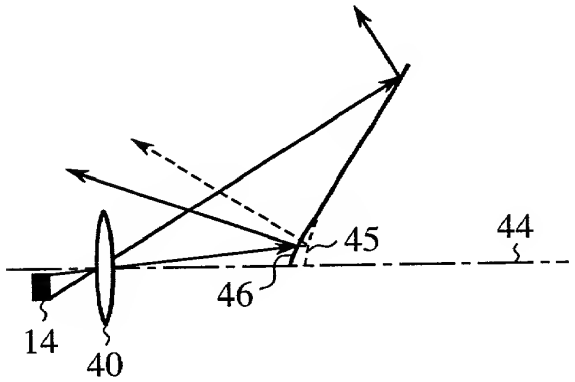


FIG.16

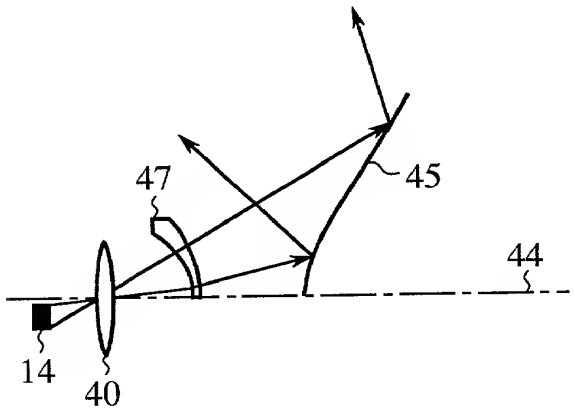


FIG.17

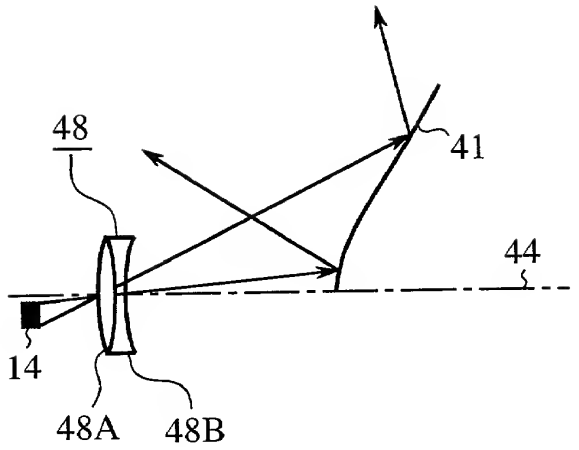


FIG.18

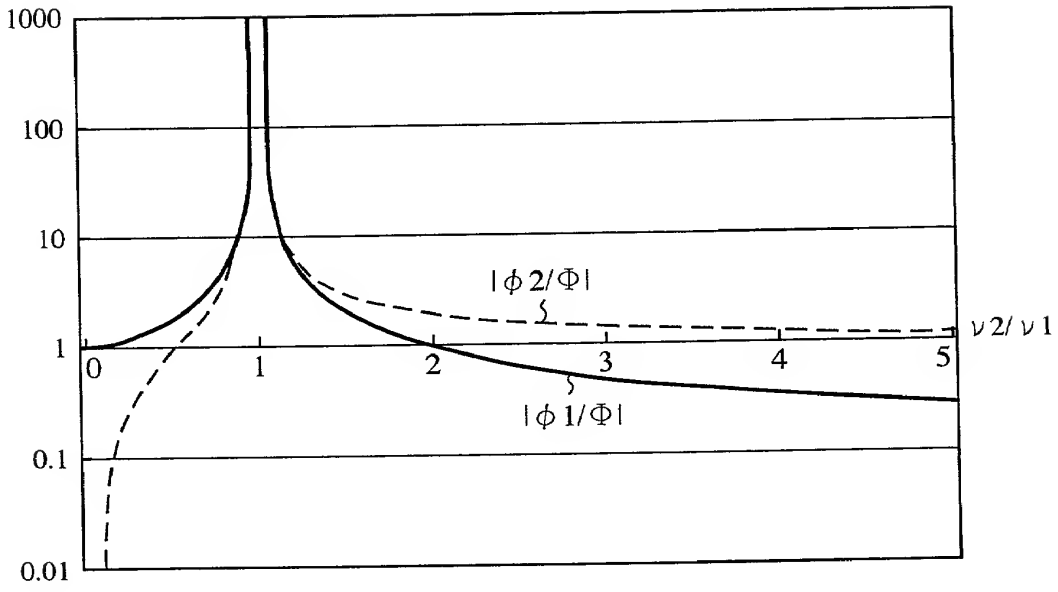


FIG.19A

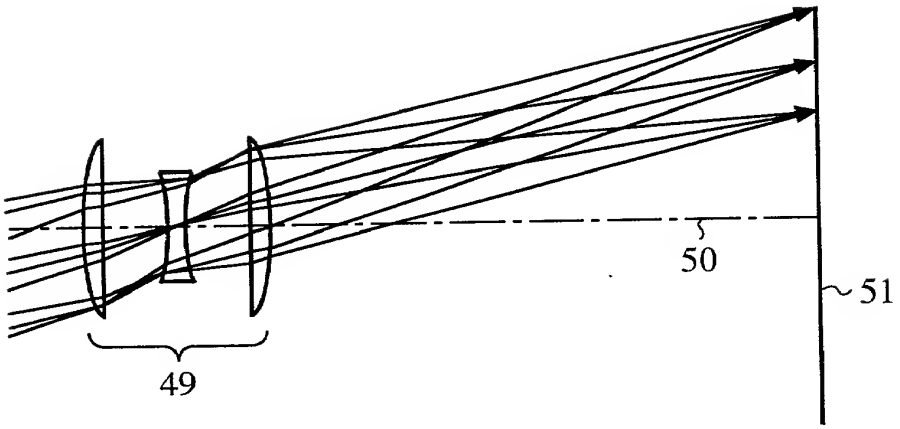


FIG.19B

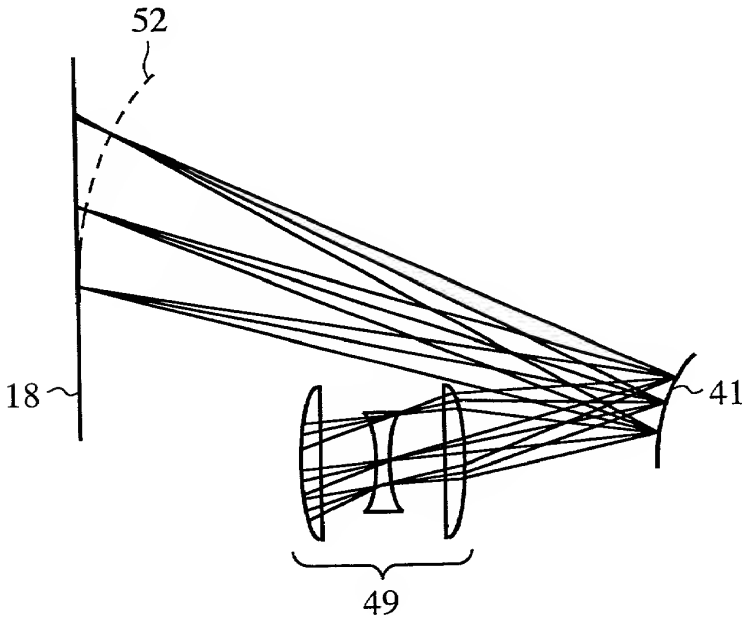


FIG.20

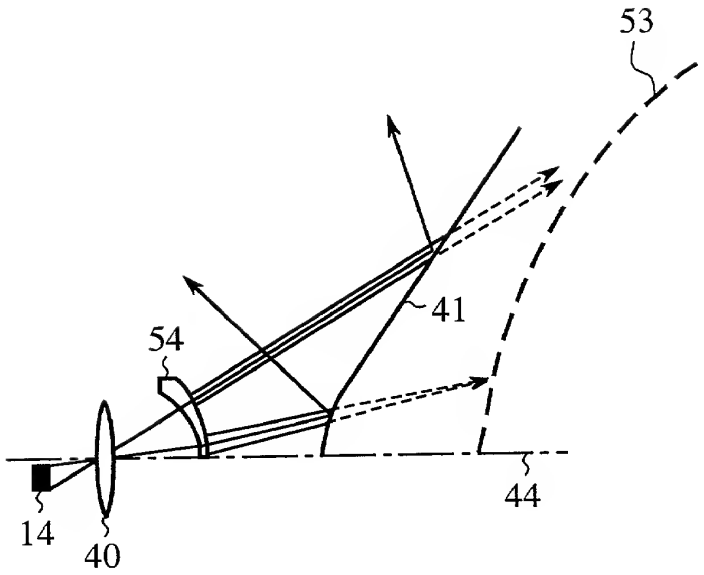


FIG.21

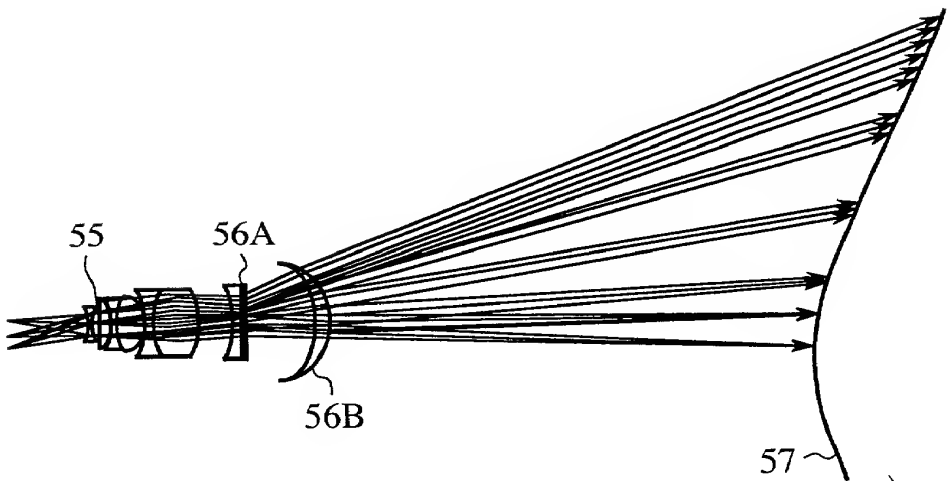


FIG.22

CONFIGURATION DATA

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
stop	2	∞	0		
	3	-14.66425866	1	1.673	32.2
	4	19.57365899	3.4	1.800	42.3
a1	5	-71.52517928	0.2		
	6	46.57431333	5.7	1.734	51.1
	7	-18.29405936	0.2		
	8	-40.70466802	2.8	1.689	31.2
	9	29.58192706	0.601907206		
	10	40.63225731	10.4	1.734	51.1
	11	-18.55101371	0.2		
	12	-21.25419861	1.2	1.620	36.3
	13	36.18745731	18	1.805	25.5
	14	-52.79556347	18.44366577		
	15	-22.2362126	2.6	1.699	30.1
	16	-373.1950411	0.2		
	17	-377.4162065	1.5	1.583	30.2
a2	18	-377.4162065	28		
	19	-36.51210431	4.3	1.493	58.3
a3	20	-27.84174798	200		
a4	21	99.76542177	-185	mirror	
	22	∞	235	mirror	
	23	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	5(a1)	18(a2)
k	-27.07818351	411.8441246
A	5.8307554E-05	7.9259800E-06
B	2.2448345E-07	1.3052778E-08

SURFACE NO.	20(a3)	21(a4)
k	-0.185161669	-4.423779483
AR1	0	0.001258226
AR2	0.003607536	-0.000570833
AR3	-2.0171885E-05	1.9194137E-07
AR4	2.9870872E-06	-3.4523509E-09
AR5	1.2983498E-07	5.7545484E-11
AR6	-6.5096954E-09	2.1100900E-14
AR7	6.2670569E-11	-2.1391081E-15
AR8	1.9677727E-12	5.9659829E-18

FIG.23B

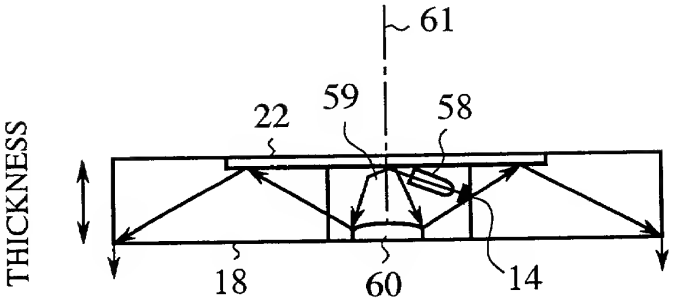


FIG.23C

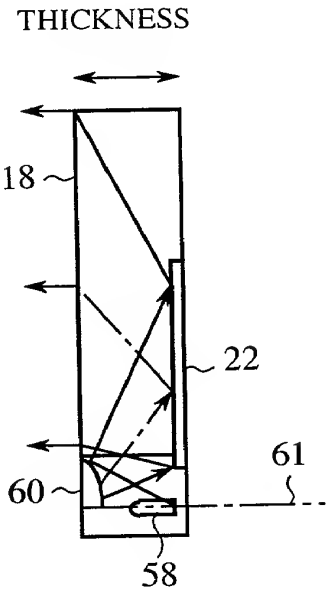


FIG.23A

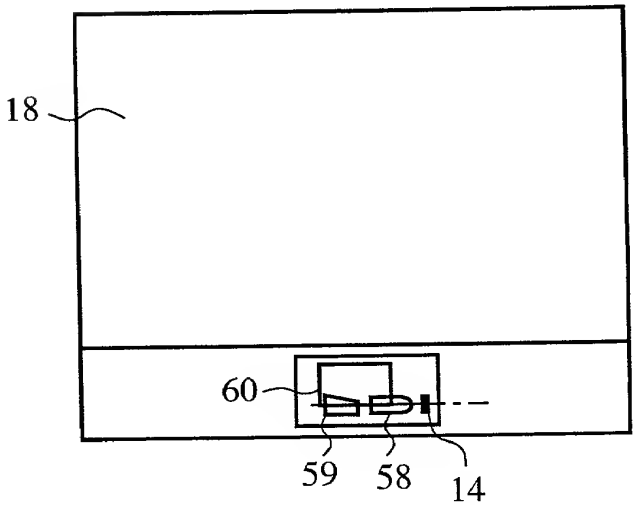


FIG.24B

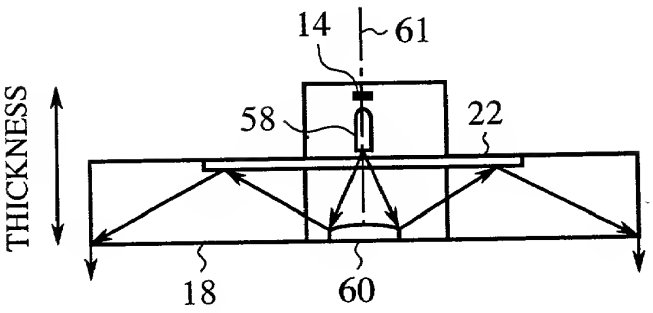


FIG.24A

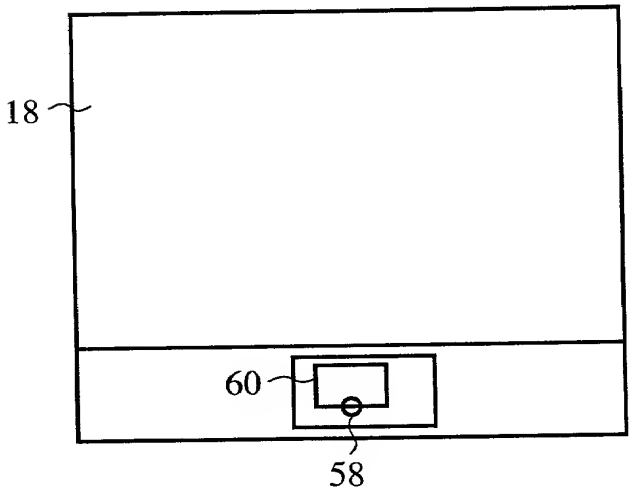


FIG.24C

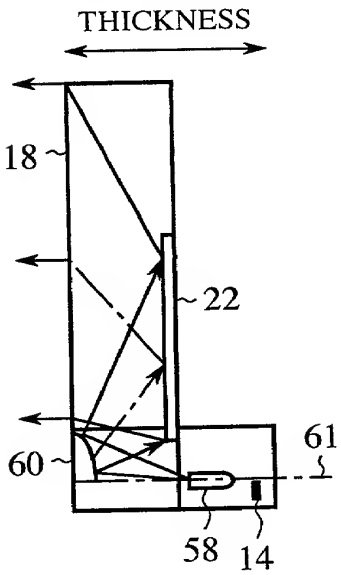


FIG.25B

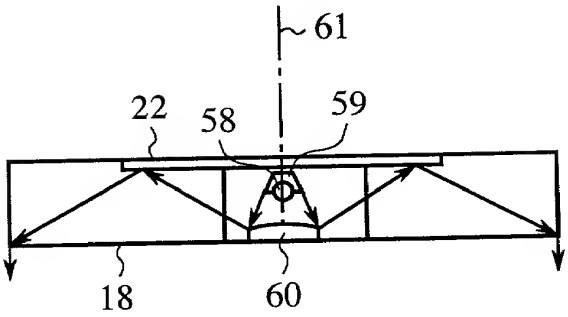


FIG.25A

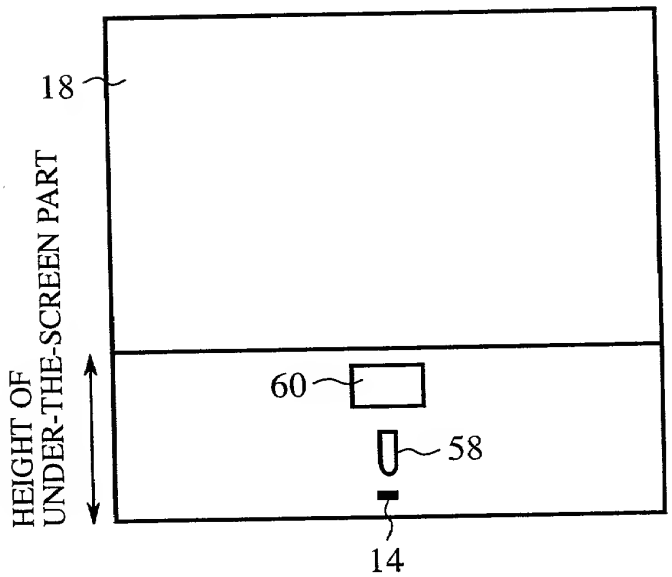


FIG.25C

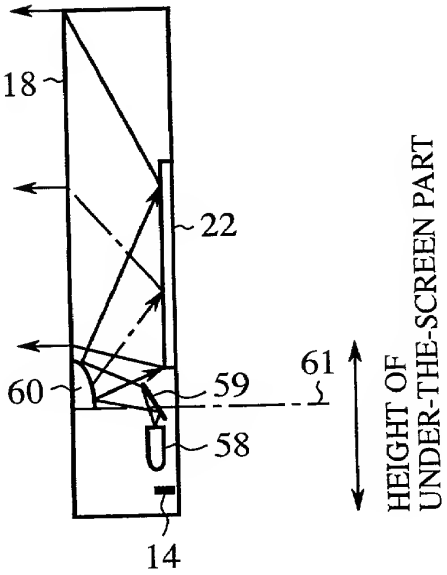


FIG.26

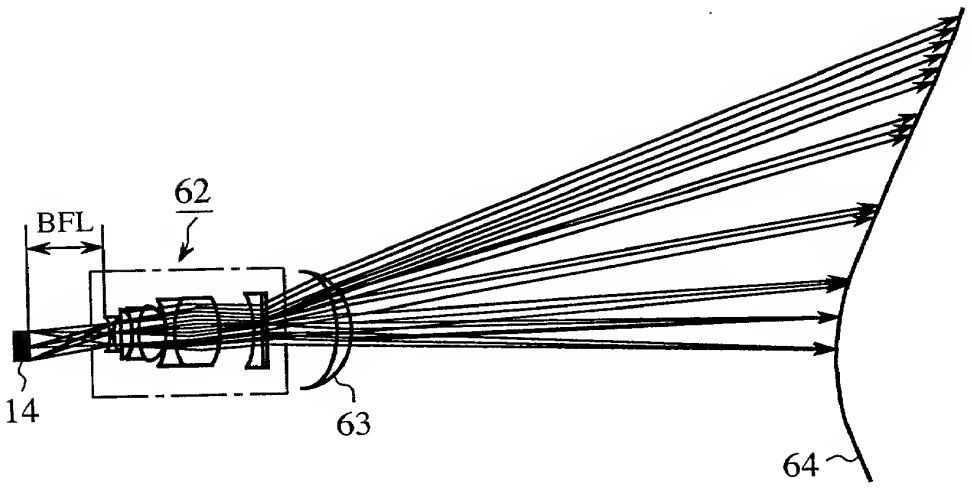


FIG.27A

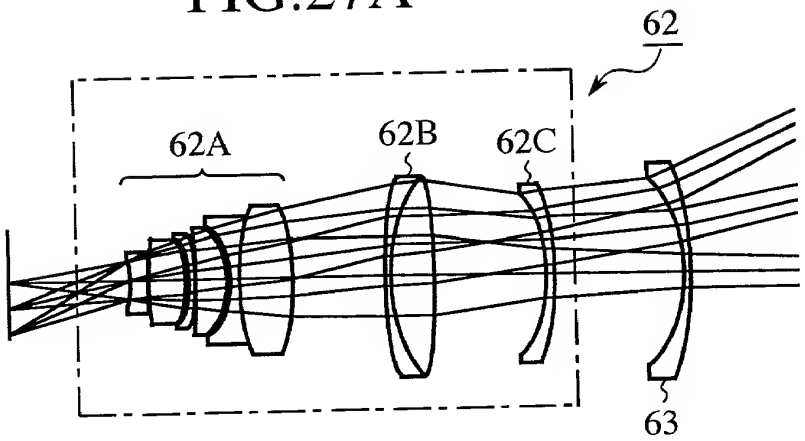


FIG.27B

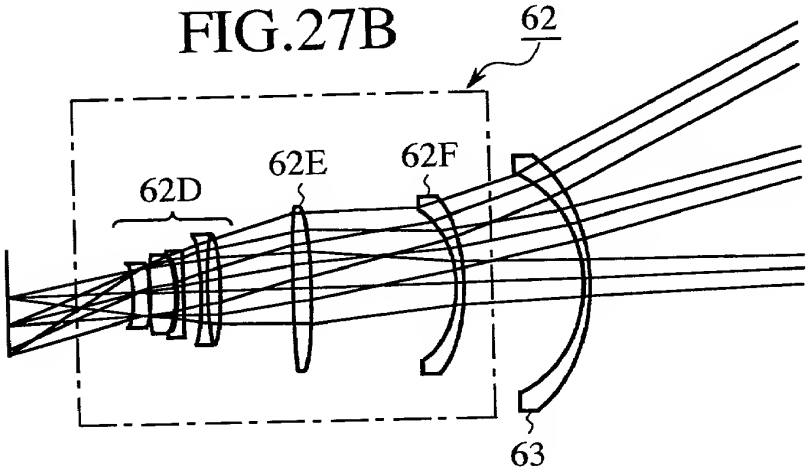


FIG.27C

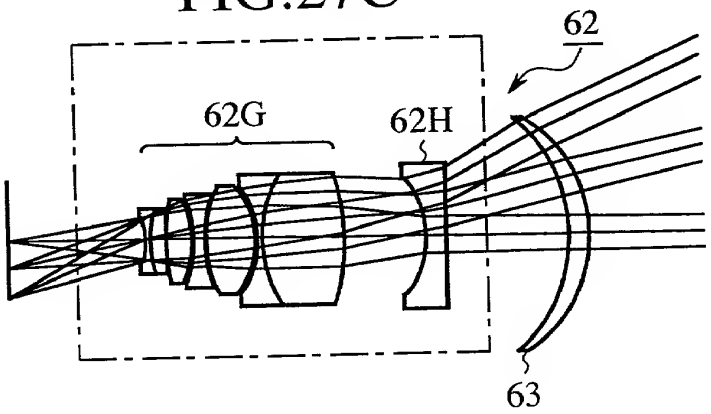


FIG.28

CONFIGURATION DATA

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
stop	2	-20.6576453533	4.7	1.468	33.8
	3	-80.5590059694	0.2		
	4	105.1808714030	9	1.795	45.4
	5	-22.7193673760	0.856893940799		
	6	-17.3195136863	1.5	1.699	30.1
	7	-36.5709492186	0.1		
	8	∞	0		
	9	-117.4048328480	8.4	1.734	51.1
	10	-18.4433151695	0.610560115593		
	11	-18.0444912892	2	1.717	29.5
	12	58.2778027126	0.1		
	13	60.6427596822	13.5	1.755	52.3
	14	-48.8581369974	22.9151946067		
	15	134.5886723560	1.5	1.670	39.3
	16	50.1278660368	0.2		
	17	50.1825926071	10.4	1.805	25.5
	18	-127.7639461820	28.4346465294		
	19	-37.7652148481	2	1.805	25.5
	20	-67.5410544326	32.6137406027		
	21	-38.6933083141	1.5	1.805	25.5
a1	22	-72.6271254361	200		
a2	23	97.9695439905	-185		mirror
	24	∞	235		mirror
	25	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	22(a1)
k	0
A	2.14260670628E-06
B	-4.79111799587E-10
C	-7.8046619422E-14

SURFACE NO.	23(a2)
k	-5.24681962734
AR1	0.00196450411864
AR2	-0.000239993326253
AR3	3.63342308137E-07
AR4	-9.24814356675E-09
AR5	7.39934860564E-12
AR6	2.02289771668E-13
AR7	-3.98993312603E-16
AR8	-6.84585972298E-19

FIG.29

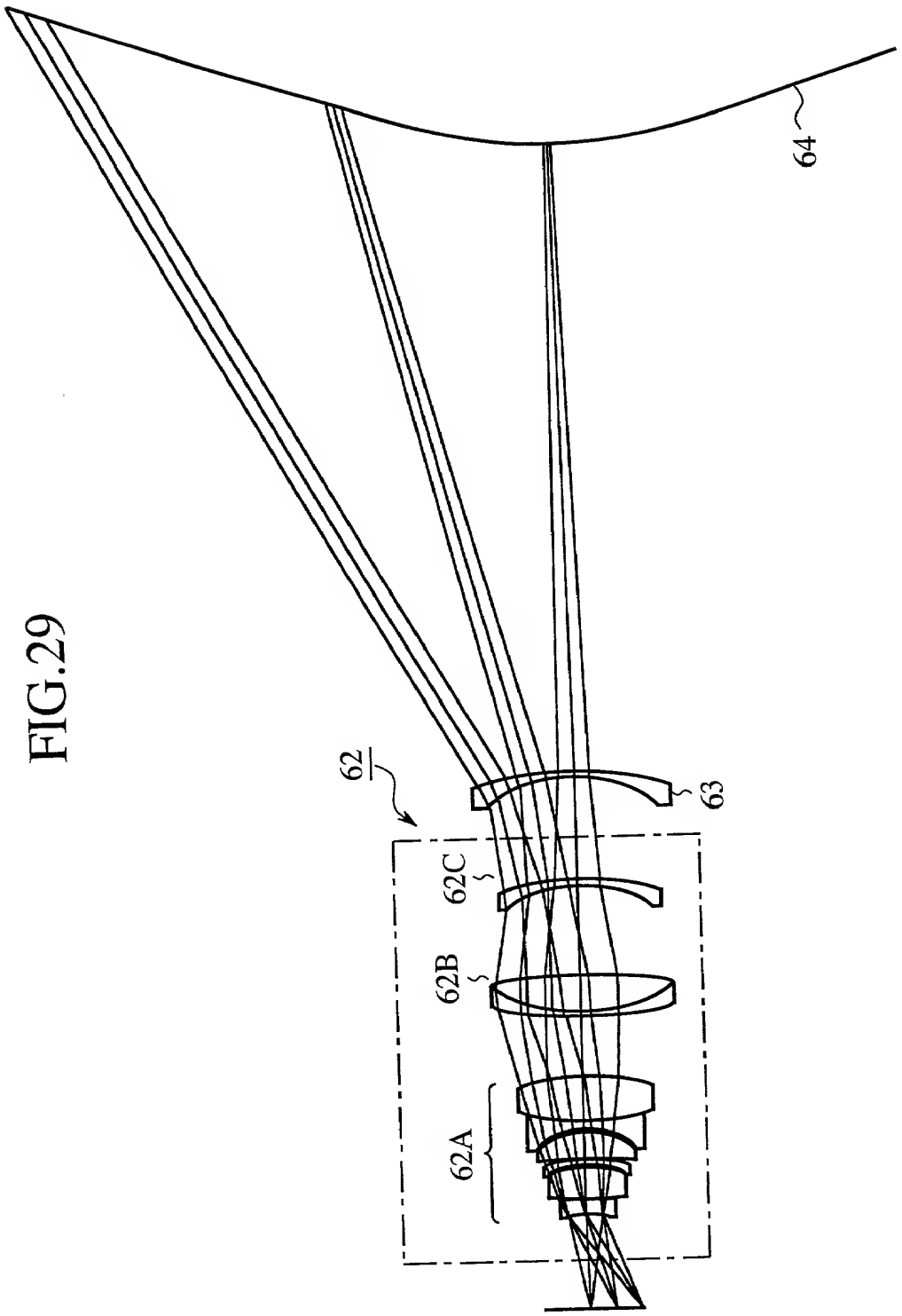


FIG.30

CONFIGURATION DATA

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
stop	2	∞	0		
	3	-12.2904711278	4.4	1.805	25.5
	4	-16.4195184751	0.2		
	5	104.5354229330	5.7	1.788	47.5
	6	-19.6319108577	1.17708106134		
	7	-17.3104022925	1	1.805	25.5
	8	-99.5878191538	3.78999966183		
	9	-64.4356830029	1.8	1.689	31.2
	10	405.8043036740	0.1		
	11	205.5484851810	3.8	1.773	49.6
	12	-37.9436126442	16.3275458444		
	13	351.0732445020	5.2	1.805	39.6
	14	-66.7950420770	34.6140975436		
	15	-25.3154161226	1.3	1.581	40.9
	16	-49.5460449762	28		
	17	-30.6367731626	1.3	1.487	70.4
a1	18	-41.3463744375	200		
a2	19	99.7565078437	-185		mirror
	20	∞	235		mirror
	21	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	18(a1)	19(a2)
k	0.26122774128	-4.84979881319
AR1	5.08543725099E-04	0.00113628431
AR2	-2.31479750093E-04	-3.98908468387E-04
AR3	-1.06950444718E-05	1.91130104677E-07
AR4	3.86431430675E-06	-5.95426848631E-09
AR5	-4.74490920644E-08	4.64306112540E-11
AR6	-9.03166761795E-10	6.54614682822E-14
AR7	3.49012367035E-11	-1.74594047087E-15
AR8	5.98706752604E-14	4.67473510700E-18

FIG.31

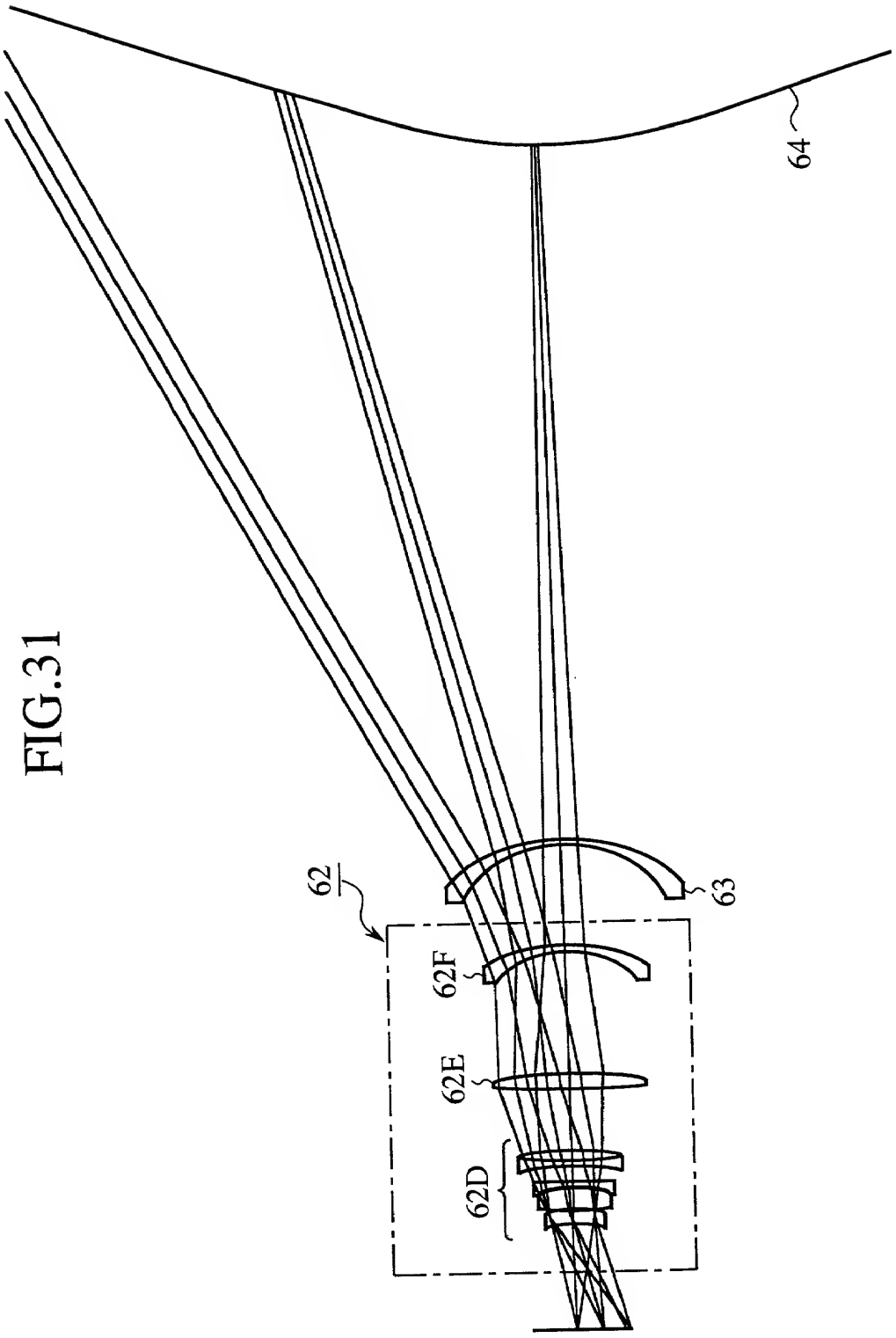


FIG.32

CONFIGURATION DATA

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
stop	2	∞	0		
	3	-14.8674137388	1	1.673	32.2
	4	18.5559337996	3.4	1.800	42.3
a1	5	-74.0536848715	0.2		
	6	43.6696369615	5.7	1.734	51.1
	7	-18.5192833307	0.2		
	8	-40.4744736638	2.8	1.689	31.2
	9	28.1242054109	0.721410946123		
	10	39.1984702090	10.4	1.734	51.1
	11	-18.6885145614	0.2		
	12	-21.0924464244	1.2	1.620	36.3
	13	34.4444350214	18	1.805	25.5
	14	-51.9422716099	18.3565287687		
	15	-22.3972908894	4.1	1.699	30.1
a2	16	-479.2220790420	28		
	17	-36.7674341411	4.3	1.487	70.4
a3	18	-27.7830763359	200		
a4	19	99.7654217668	-185		mirror
	20	∞	235		mirror
	21	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	5(a1)	16(a2)
k	-30.6753040764	689.5547308060
A	5.71039286720E-05	7.13647300379E-06
B	2.25311896143E-07	1.19485813073E-08

SURFACE NO.	18(a3)	19(a4)
k	-0.1793477113	-4.4237794828
AR1	0	0.0012582257858
AR2	0.00365144111288	-0.000570832798628
AR3	-2.08418127864E-05	1.91941370309E-07
AR4	3.06790134130E-06	-3.45235087113E-09
AR5	1.28809224318E-07	5.75454836583E-11
AR6	-6.46419170810E-09	2.11008995385E-14
AR7	5.60800488063E-11	-2.13910807996E-15
AR8	2.10739642573E-12	5.96598292076E-18

FIG.33

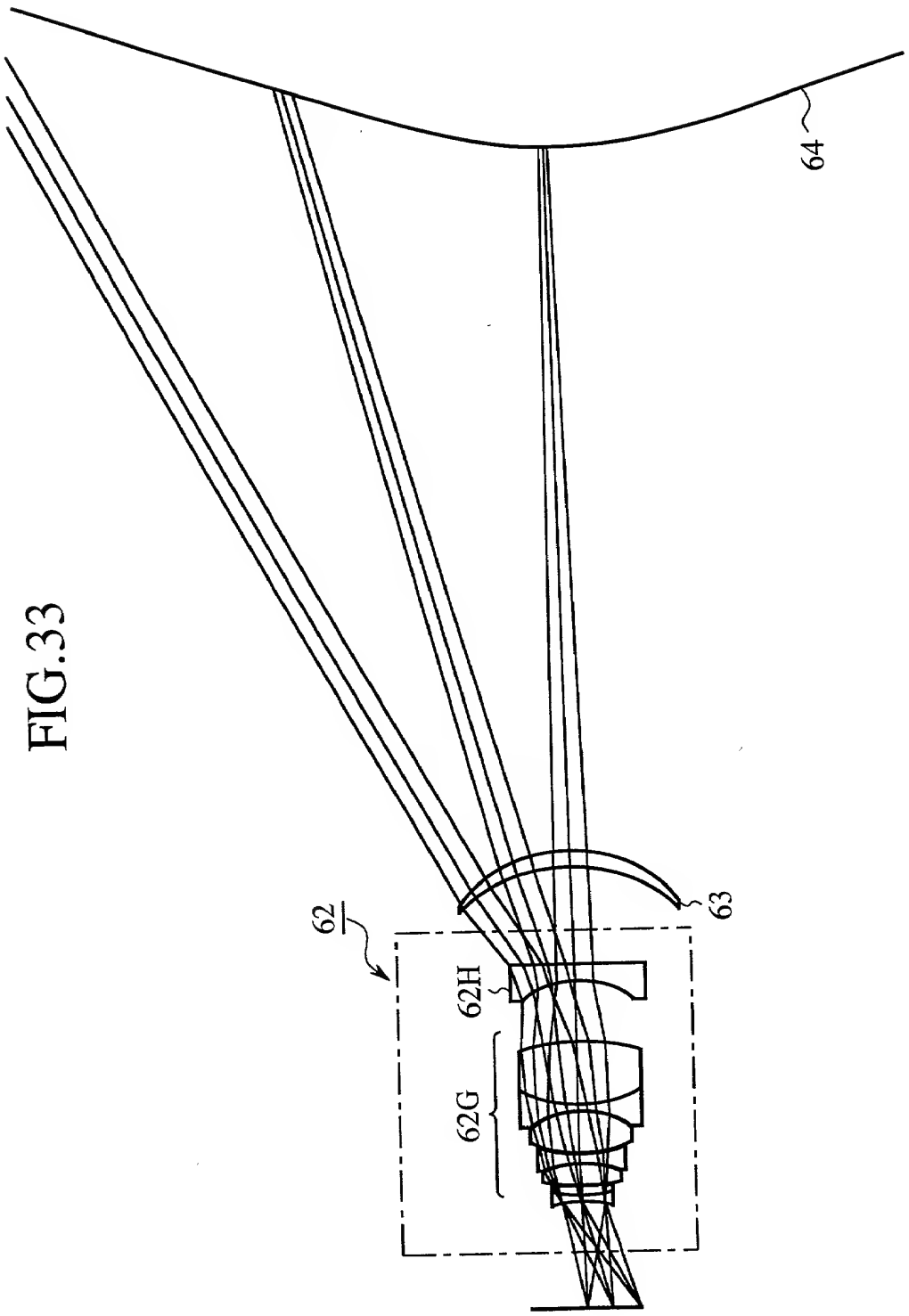


FIG.34

CONFIGURATION DATA

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
	2	∞	0		
	3	-15.44465	1	1.673	32.2
	4	22.29631	3.4	1.806	40.7
a1	5	-213.55978	0.2		
	6	39.68662	5.7	1.697	55.5
stop	7	-21.23434	0.2		
	8	-76.49347	2.8	1.689	31.2
	9	24.81811	0.28796		
	10	28.11617	10.0	1.734	51.1
	11	-19.46732	0.5		
	12	-21.07916	2.0	1.620	36.3
	13	41.20070	17.2	1.805	25.5
	14	-47.74581	20.2		
	15	-19.64666	1.8	1.699	30.1
	16	-285.50057	1.2		
	17	-296.46506	2.3	1.583	30.2
a2	18	-296.46506	22		
	19	-41.83187	6.5	1.493	58.3
a3	20	-28.78769	222.6		
a4	21	101.38793	-185		mirror
	22	∞	235		mirror
	23	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	5(a1)	18(a2)
k	94.803794	231.121259
A	5.68235E-05	7.22298E-06
B	9.96524E-08	1.21095E-08

SURFACE NO.	20(a3)	21(a4)
k	-0.034091	-4.2611
AR1	0	0.0017037
AR2	2.3760E-03	-5.4703E-04
AR3	-1.3655E-05	2.2681E-07
AR4	2.0976E-06	-3.7501E-09
AR5	1.6646E-07	5.5657E-11
AR6	-7.5921E-09	2.2956E-14
AR7	6.4636E-11	-2.0653E-15
AR8	2.7930E-12	5.8043E-18

FIG.35

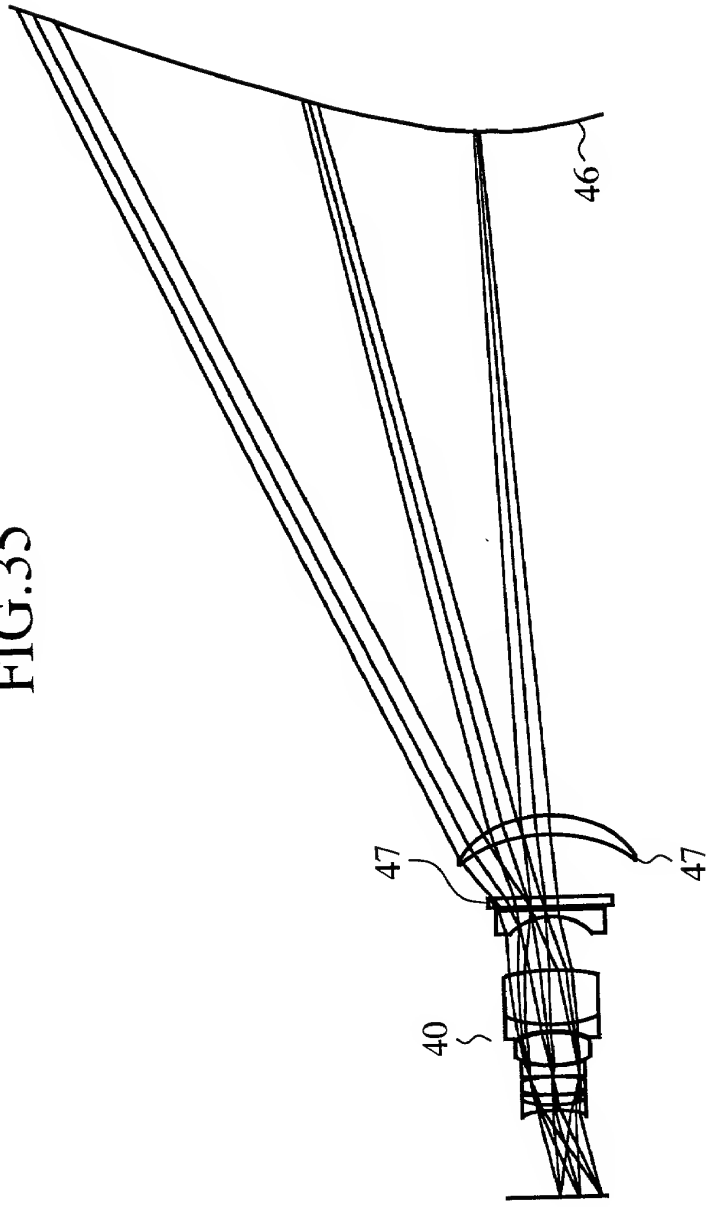


FIG.36

CONFIGURATION DATA

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
	2	∞	0		
	3	-17.34243	1	1.673	32.2
	4	18.31171	3.4	1.806	40.7
a1	5	-431.65942	0.2		
	6	29.08428	5.7	1.697	55.5
stop	7	-22.39460	0.2		
	8	-70.37449	2.8	1.689	31.2
	9	20.78432	0.422916		
	10	24.46057	10	1.734	51.1
	11	-25.60922	0.5		
	12	-27.87924	2.0	1.620	36.3
	13	33.45787	17.2	1.805	25.5
	14	-48.80317	20.2		
	15	-16.72859	1.8	1.699	30.1
	16	-472.97398	1.2		
	17	-432.97164	2.3	1.583	30.2
a2	18	-432.97164	18.59086		
	19	-47.05214	12	1.487	70.4
	20	-31.45896	0.2		
	21	-34.76999	2	1.493	58.3
a3	22	-36.76734	205.6		
a4	23	100.46532	-185		mirror
	24	∞	235		mirror
	25	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	5(a1)	18(a2)
k	1123.385176	453.751298
A	5.72413E-05	1.02654E-05
B	1.15746E-07	-1.71142E-09

SURFACE NO.	22(a3)
k	0.306525
A	8.66086E-07
B	1.02860E-09
C	-1.51387E-12
D	1.15559E-15

SURFACE NO.	23(a4)
k	-4.3207
AR1	2.0932E-03
AR2	-5.3836E-04
AR3	3.0012E-07
AR4	-3.7476E-09
AR5	5.3519E-11
AR6	9.5182E-15
AR7	-2.0763E-15
AR8	6.2448E-18

FIG.37

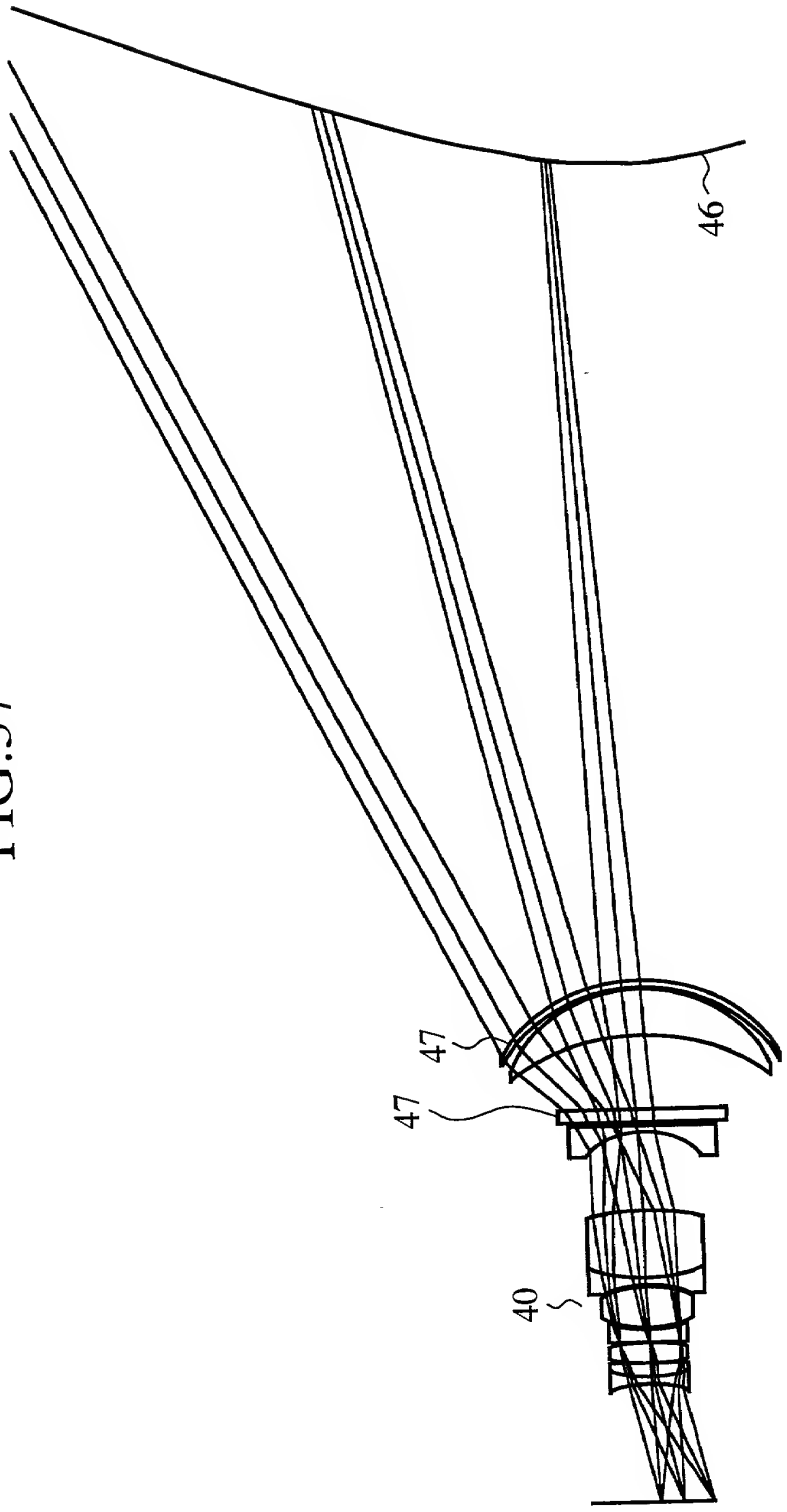


FIG.38

CONFIGURATION DATA

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
stop	2	-13.4261664433	4.4	1.805	25.5
	3	-18.5697706537	0.1		
	4	∞	0		
	5	96.5265031257	5.7	1.788	47.5
	6	-17.4308819114	0.397498402225		
	7	-16.4228675060	1	1.805	25.5
	8	-60.2043783294	1.342174017		
	9	-73.1869001667	1.8	1.689	31.2
	10	173.0147244620	0.780042494674		
	11	-129.3791808580	2.8	1.773	49.6
	12	-33.6477898040	15.8750139763		
	13	196.0051080580	5.2	1.805	39.6
	14	-74.0063177141	52.0143705416		
	15	-28.5012732493	1.3	1.581	40.9
	16	-55.6266733382	28		
	17	-30.9418208415	1.3	1.487	70.4
a1	18	-45.9668803671	128		
a2	19	85.3955888127	-190		mirror
	20	∞	235		mirror
	21	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	18(a1)	19(a2)
k	0.192778928749	-5.6077761791170
AR1	1.774508723E-03	-0.00114723527653
AR2	-8.66337658673E-04	-4.95421889495E-04
AR3	-4.78199895283E-07	-9.97000490749E-08
AR4	4.28880134809E-06	-6.48715736783E-09
AR5	-3.13809231047E-08	4.81877304832E-11
AR6	-8.86192485666E-10	8.84967561950E-14
AR7	2.69189766537E-11	-1.65622637923E-15
AR8	-8.33108856115E-14	4.18083936646E-18

FIG.39

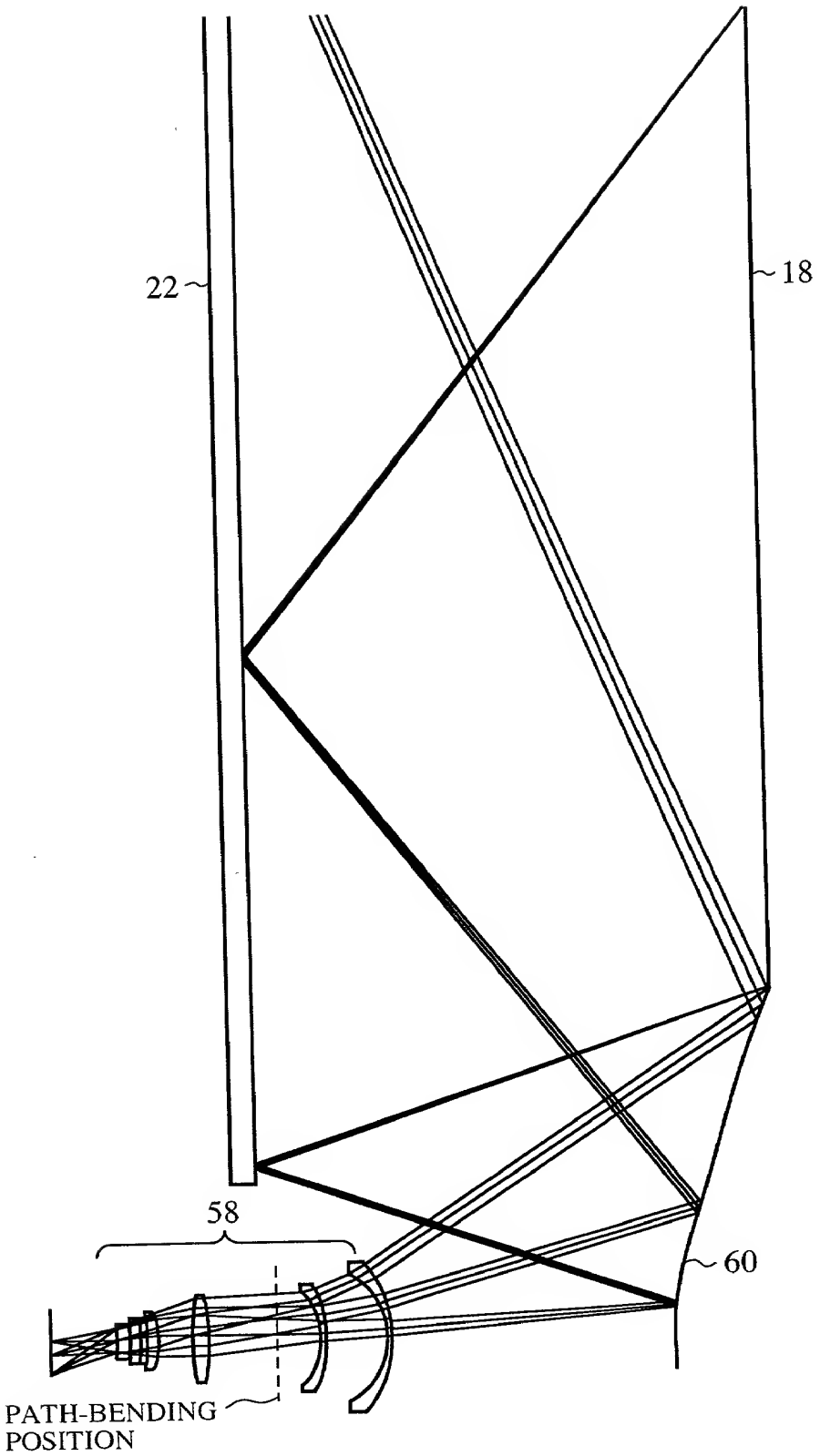


FIG.40A

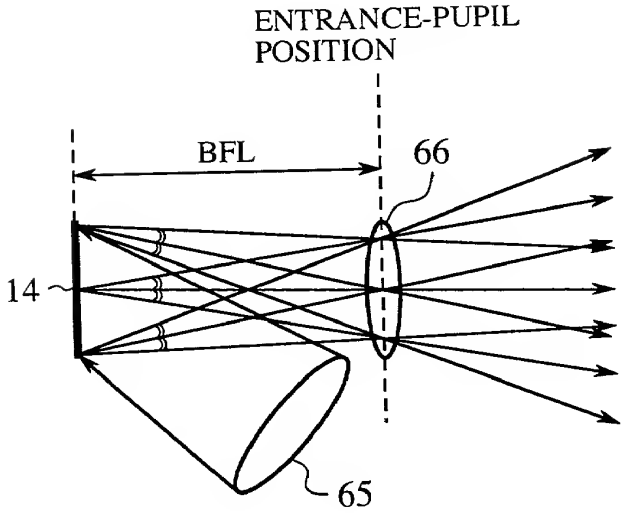


FIG.40B

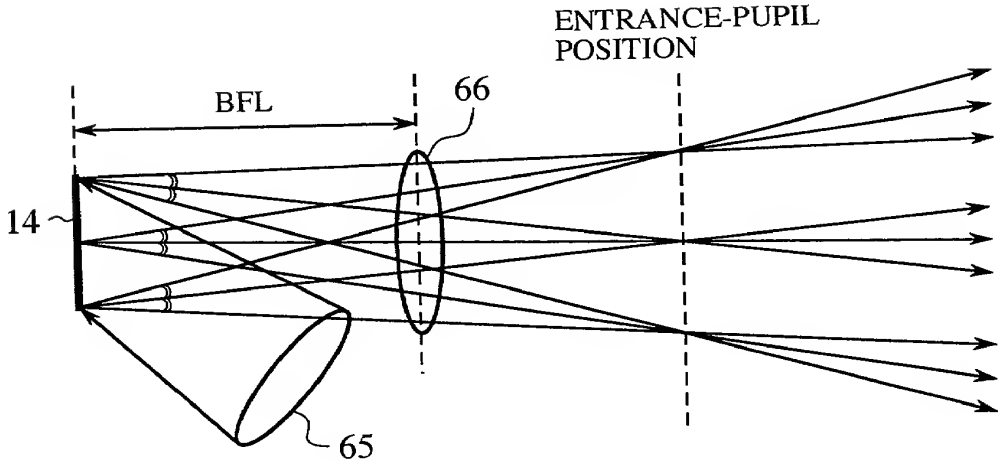


FIG.41A

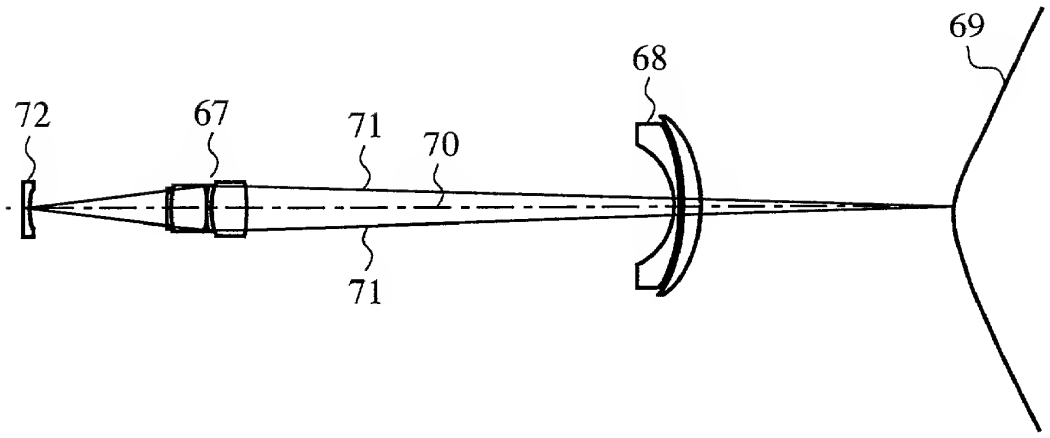


FIG.41B

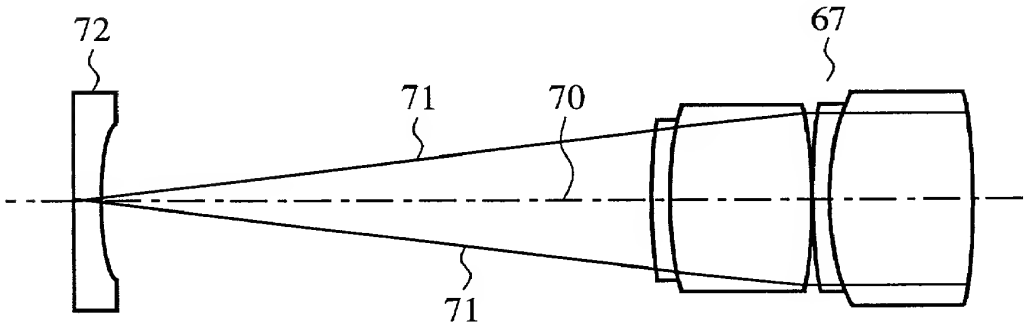


FIG.42A

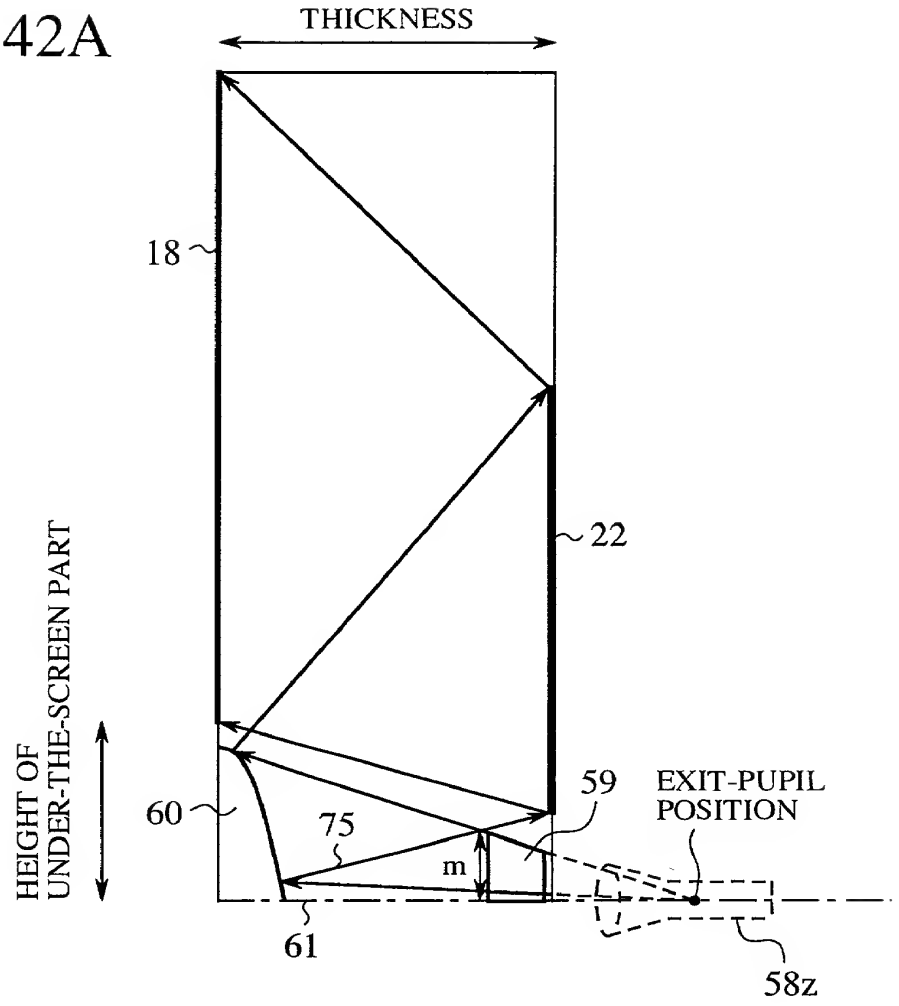


FIG.42B

FIG.42C

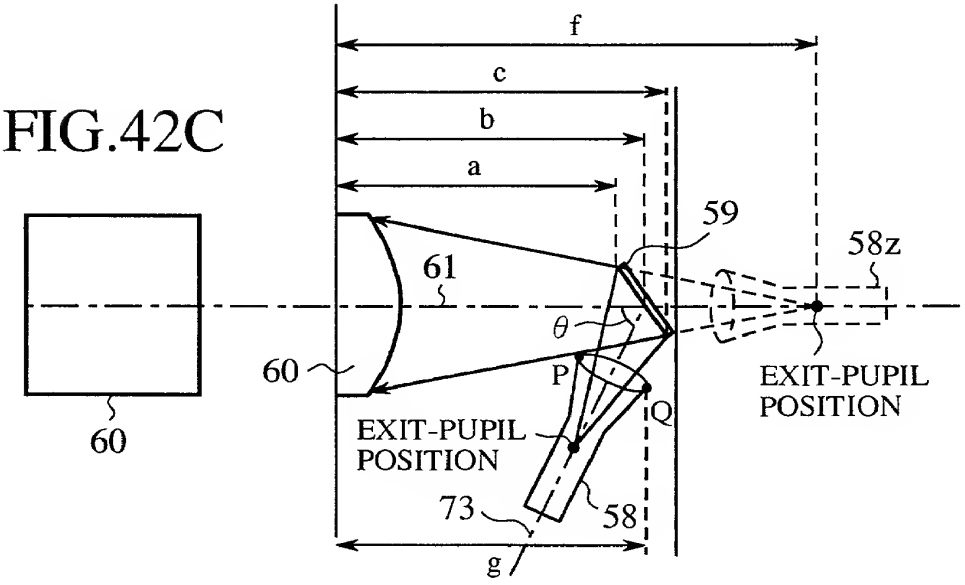


FIG.43A

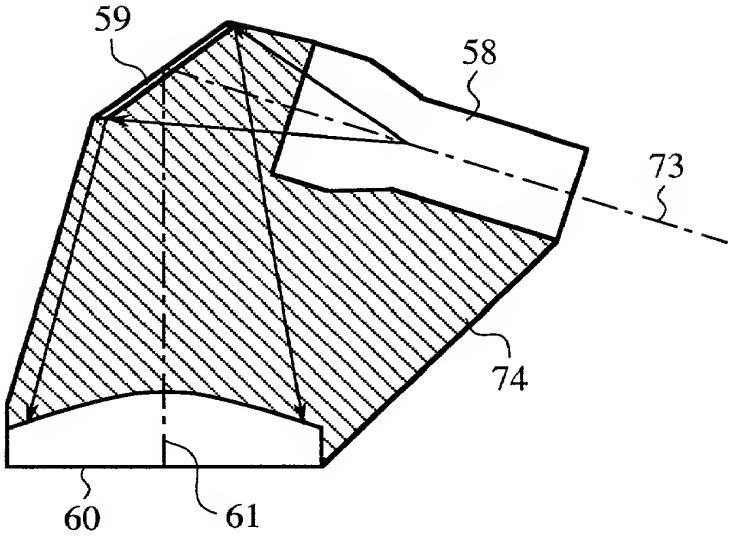


FIG.43B

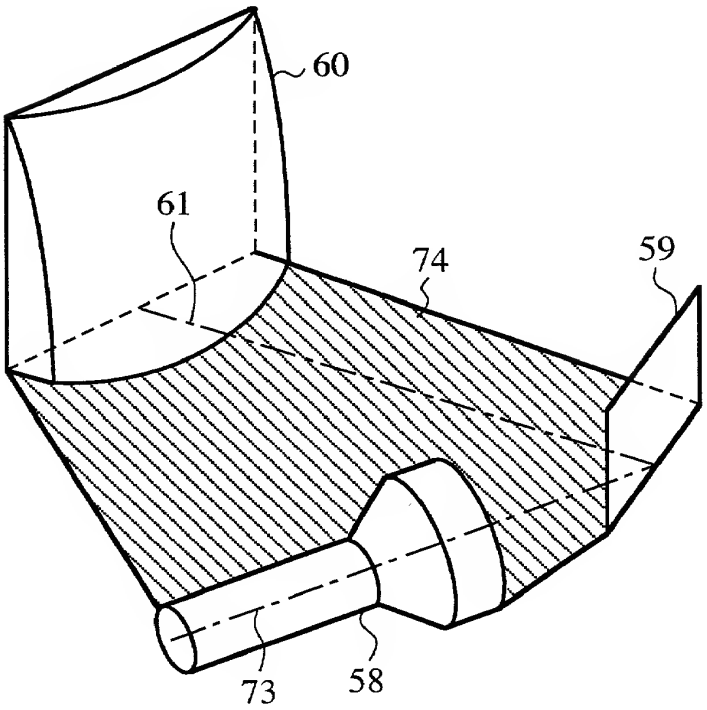


FIG.44A

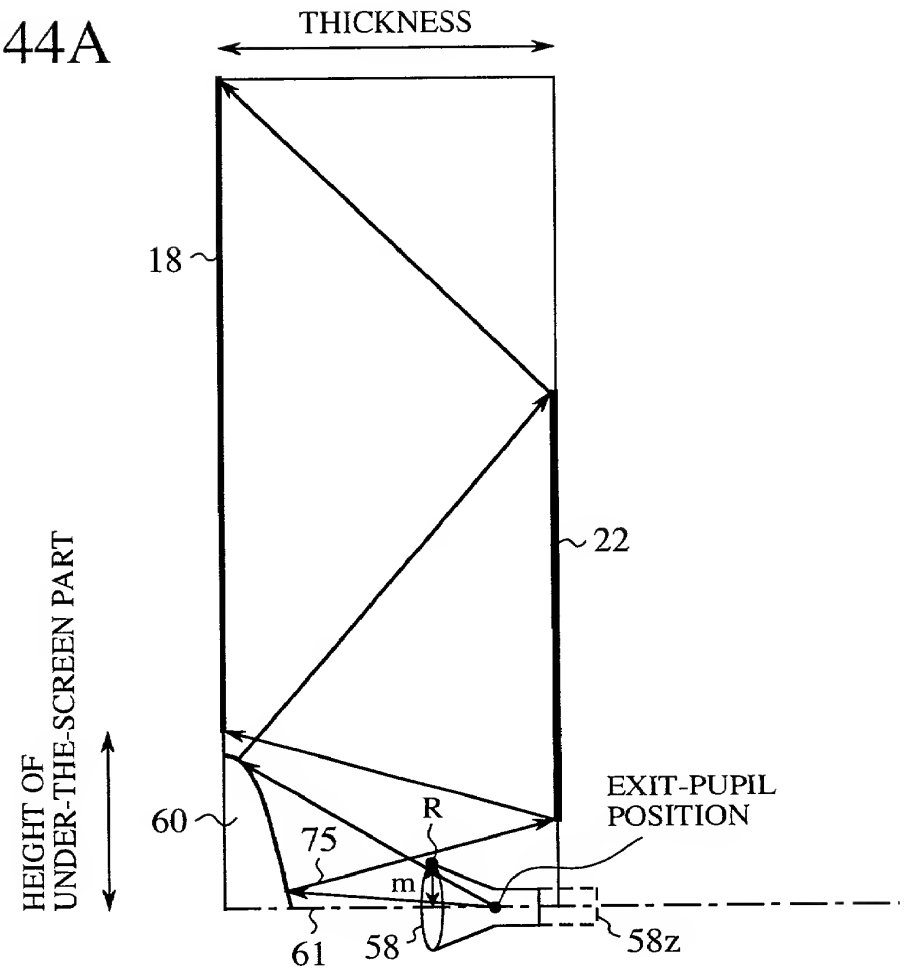


FIG.44B

FIG.44C

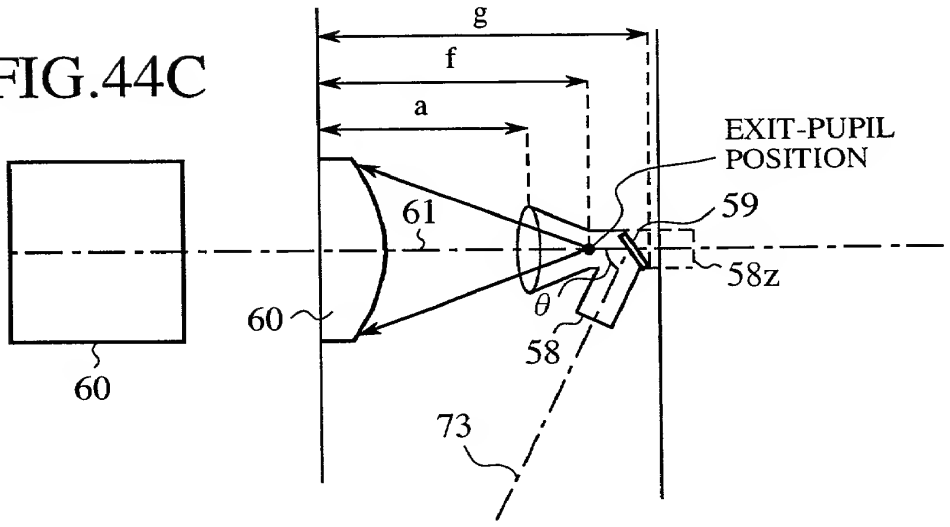


FIG.45

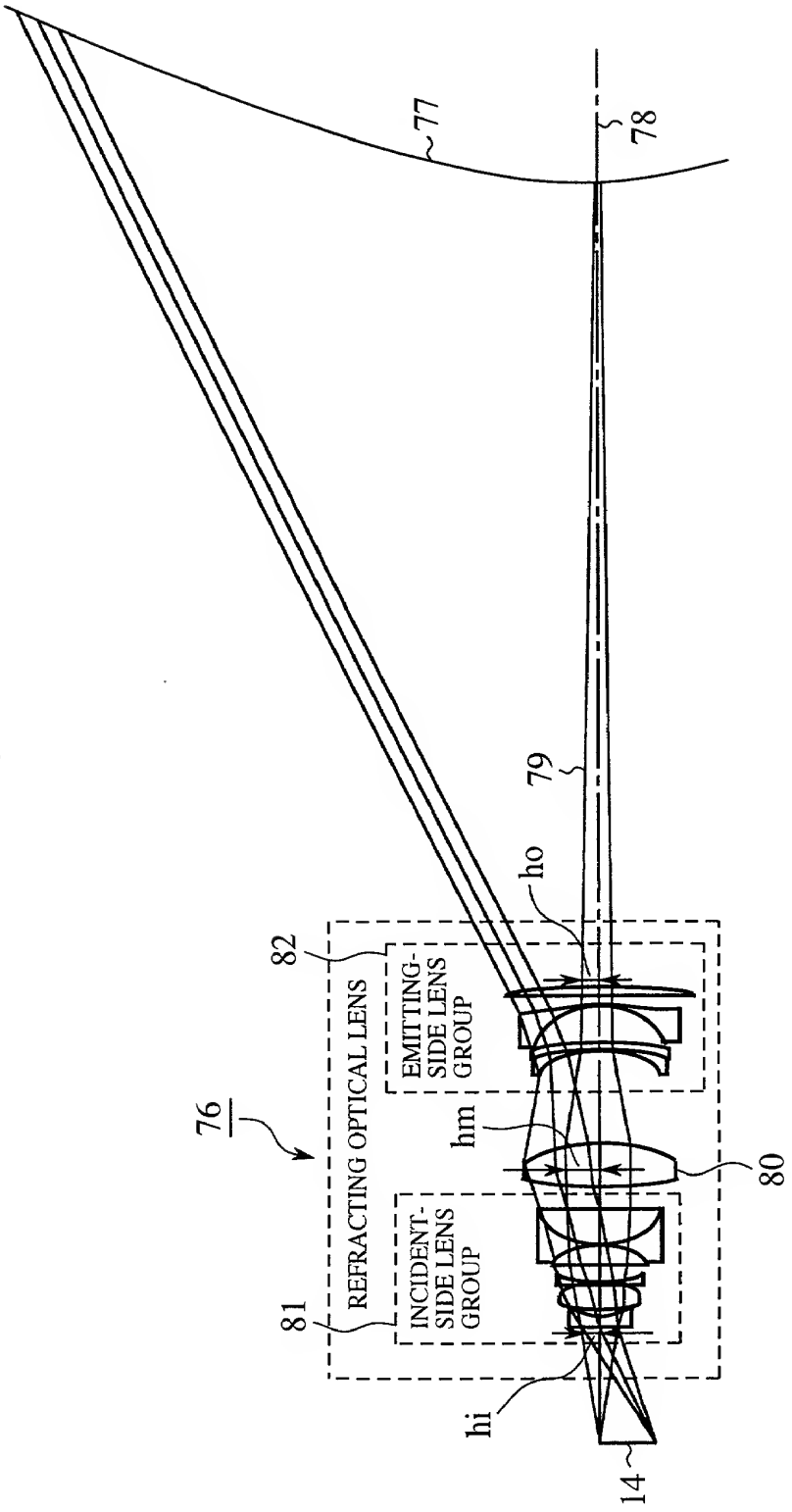

77
78
79
ho
82
EMITTING-SIDE LENS GROUP
76
hm
80
81
REFRACTING OPTICAL LENS
INCIDENT-SIDE LENS GROUP
hi
14

FIG.46

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
stop	2	∞	0.759413002		
	3	-18.08246509	1.293319809	1.645	34.2
	4	14.76967369	3.046801019	1.812	46.5
a1	5	-89.85177909	0.1		
	6	38.06047971	6.316794446	1.652	57.8
	7	-22.10508829	0.1		
	8	-369.4581445	0.75	1.669	35.9
	9	30.52687812	3.514448063		
	10	178.9300355	5.999639512	1.755	51.6
	11	-18.24854958	0.1		
	12	-20.32053065	0.75	1.609	37.1
	13	18.88427392	7.742297755	1.598	61.5
	14	118.7889006	6.210410756		
	15	75.82426822	11.42955737	1.805	25.4
	16	-45.48096773	23.85514754		
	17	-23.81858954	0.75	1.605	37.6
	18	-78.5219672	0.948010192		
	19	-51.73173658	0.75	1.578	41.3
a2	20	234.0322249	1.220004284		
	21	-80.15802174	8.419857503	1.608	60.9
	22	-20.55147589	0.75	1.808	30.7
a3	23	-48.10173307	2.848868085		
	24	-3046.703797	1.735926726	1.722	28.6
a4	25	-2.400127241	208.6471271		
a5	26	98.10117098	-185		mirror
	27	∞	235		mirror
	28	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	5(a1)	20(a2)
k	-4.32940673132E+17	-1.21836467670E+03
A	6.70013658492E-05	-5.88743894511E-06
B	1.37864501703E-07	-1.73552289497E-08
C	-7.06479501573E-10	1.18834320118E-11
D	5.53966960363E-12	-6.80318146301E-14

SURFACE NO.	23(a3)	25(a4)
k	-4.724966832	-1.50277006191E+15
A	7.74200201398E-06	-4.02340217867E-06
B	1.45468946297E-10	1.93027721059E-09
C	6.05222618687E-12	1.94579724047E-12
D	2.84368236883E-15	-5.14946061841E-15

SURFACE NO.	26(a5)
k	-4.196831481
AR1	0.002610563
AR2	-0.000642464
AR3	-4.3515321786E-07
AR4	-3.6279999567E-09
AR5	1.0315413556E-10
AR6	-1.0512922326E-13
AR7	-2.4533992418E-15
AR8	5.0201588256E-18
AR9	-7.7746688347E-21
AR10	1.8233746123E-23
AR11	4.0004474833E-25
AR12	1.9572075845E-27
AR13	-1.0853722256E-29

FIG.47

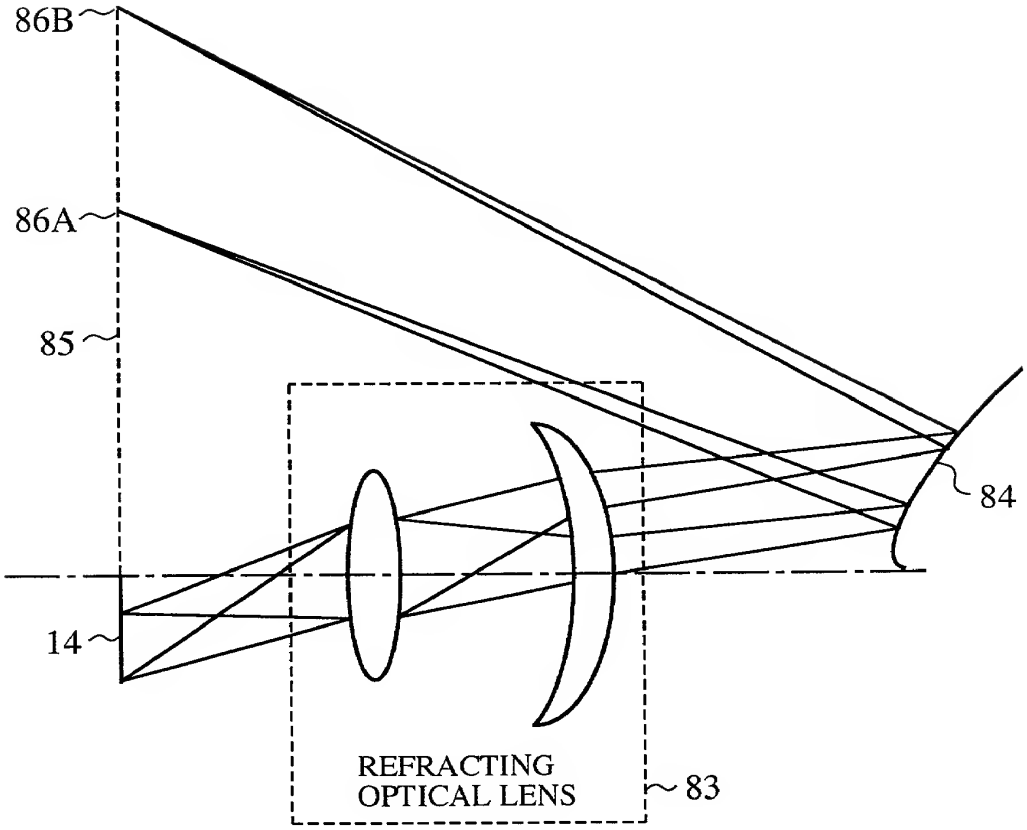


FIG.48

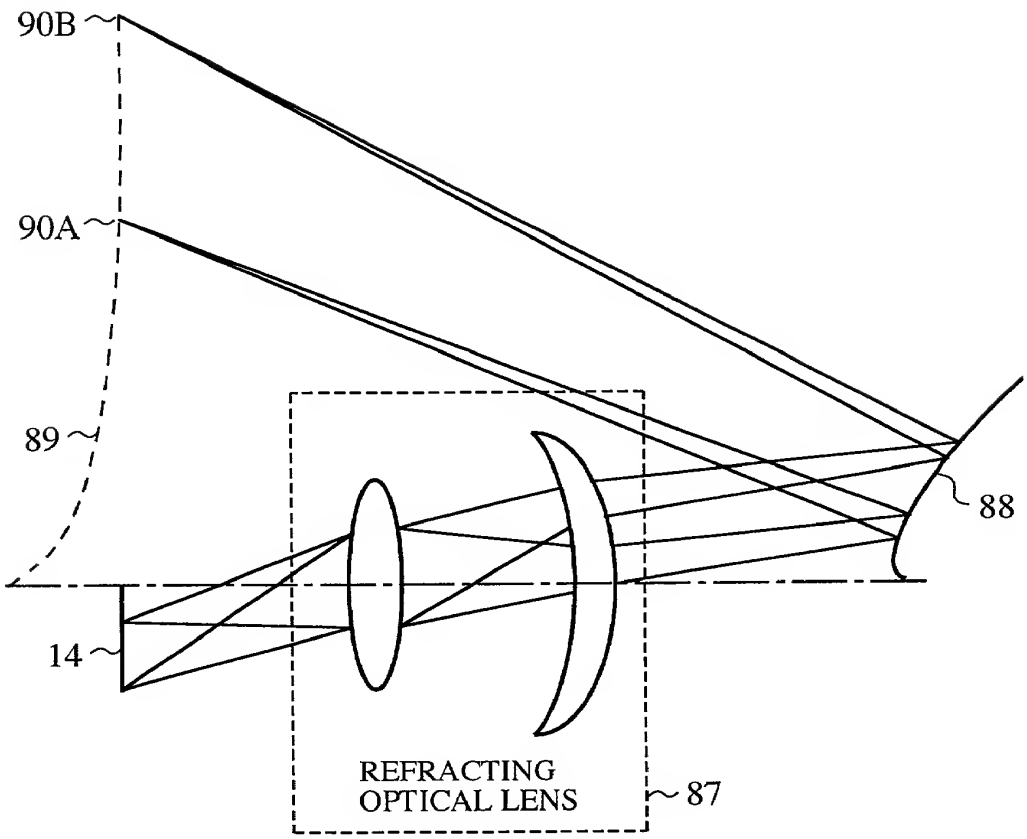


FIG.49

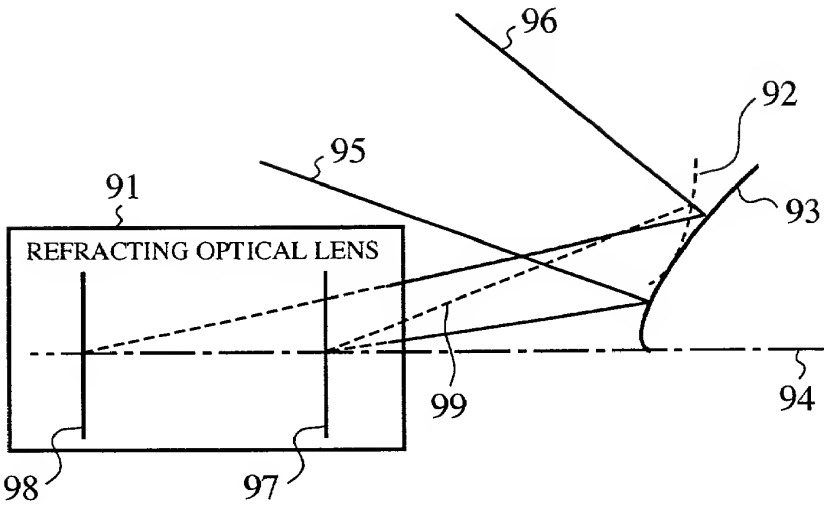

96
92
95
91
93
REFRACTING OPTICAL LENS
99
94
98
97

FIG.50

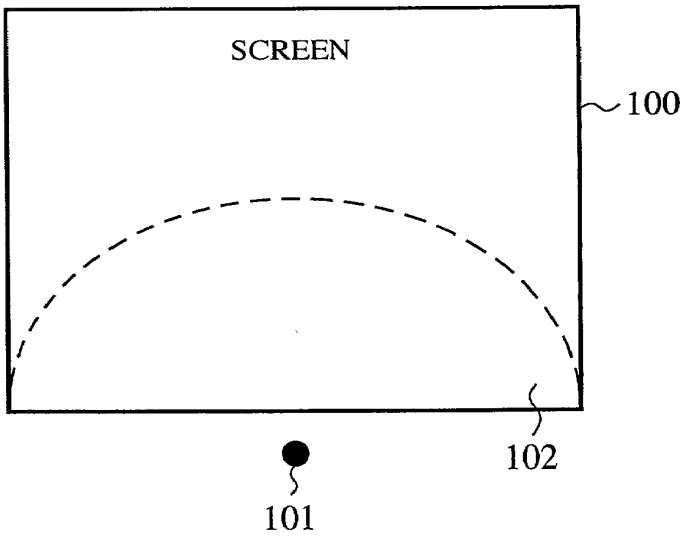

SCREEN
100
102
101

FIG.51

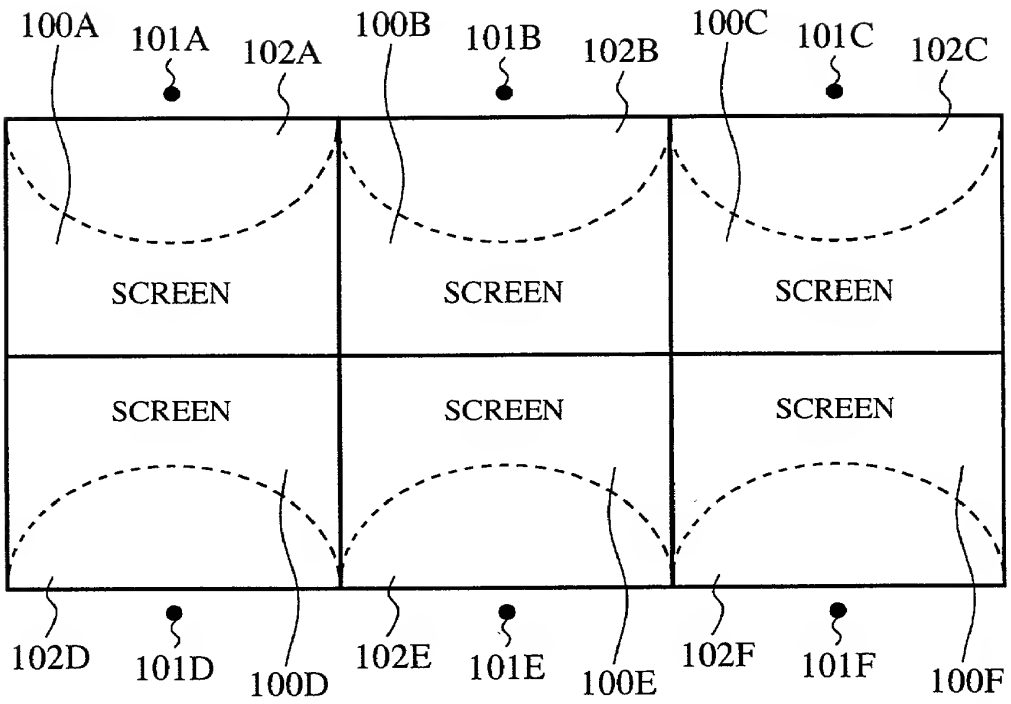

100A
101A
102A
100B
101B
102B
100C
101C
102C
SCREEN
SCREEN
SCREEN
SCREEN
SCREEN
SCREEN
102D
101D
100D
102E
101E
100E
102F
101F
100F

FIG.52

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	30		
stop	2	∞	0		
	3	-36.20569316	2.450194072	1.755200	27.5
	4	12.28575345	2.84681536	1.743300	49.3
a1	5	-51.08200239	0.1		
	6	60.74463277	4.440052074	1.729160	54.7
	7	-11.85997421	0.75	1.805181	25.5
	8	-87.60955983	18.16014798		
	9	-100.7895973	7.55	1.805181	25.5
	10	-31.95229299	0.1		
	11	55.14907044	9.008423098	1.805181	25.5
	12	-151.9493125	5.05		
	13	1123.09334	20	1.696802	55.5
	14	-24.68341928	6.516931913	1.805181	25.5
	15	-226.0041685	1.971694287		
	16	-47.77345182	1.3	1.806100	33.3
	17	19.4398449	6.997754926	1.622994	58.1
	18	122.6856621	9.290681858		
	19	-18.03371133	1	1.805181	25.5
	20	-61.36251152	0.2		
	21	-213.3989174	12.93782856	1.496997	81.6
	22	-27.11650652	0.3	1.525	49.0
a2	23	-27.1165053	220		
a3	24	97.9514514	-180		mirror
	25	∞	230		mirror
	26	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	5(a1)	23(a2)
k	-4.32940673132E+17	-6.44192632533E-02
A	2.06464810175E-05	2.25891515654E-06
B	4.22130612543E-08	1.27763942489E-09
C	-4.28109161934E-10	-1.48949338494E-12
D	3.18505494008E-12	4.41143555338E-15

SURFACE NO.	24(a3)
k	-5.890257058
A	-1.68371401519E-09
B	-3.15175891126E-13
C	1.85045591079E-17
D	-4.44896288674E-22
E	4.06924422352E-27

FIG.53

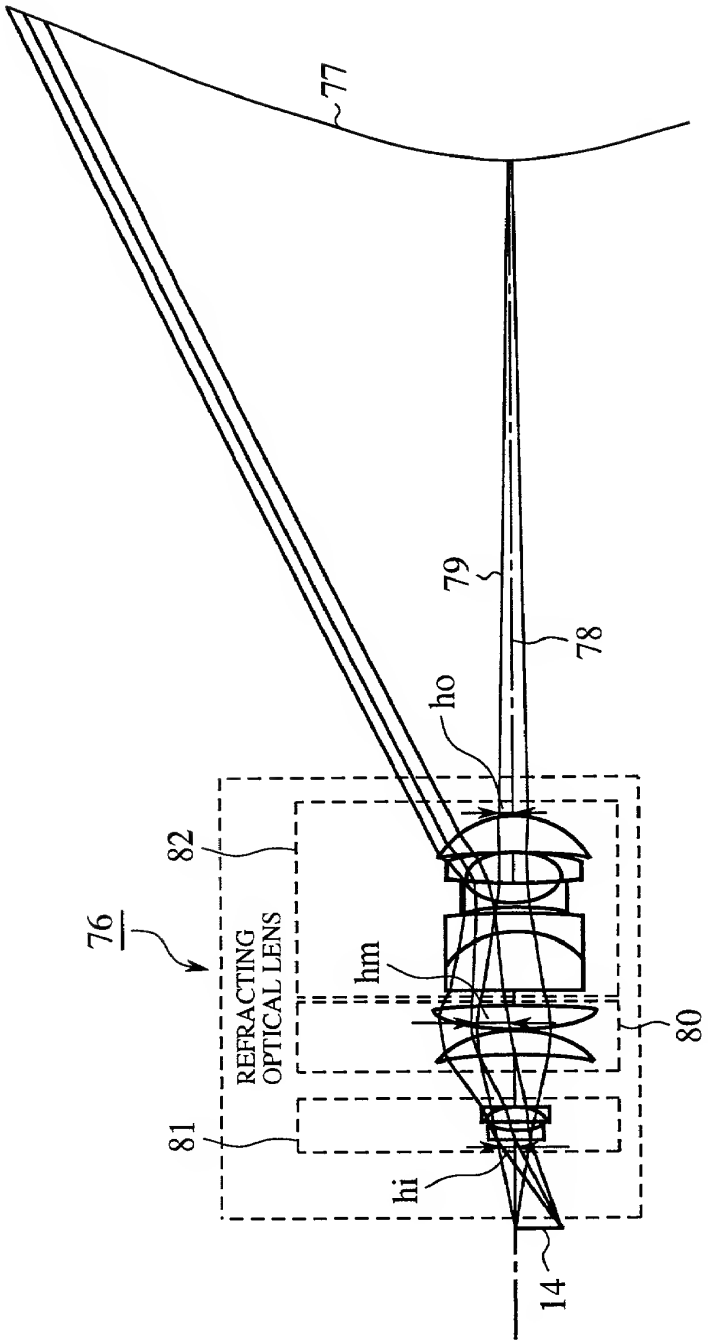


FIG.54

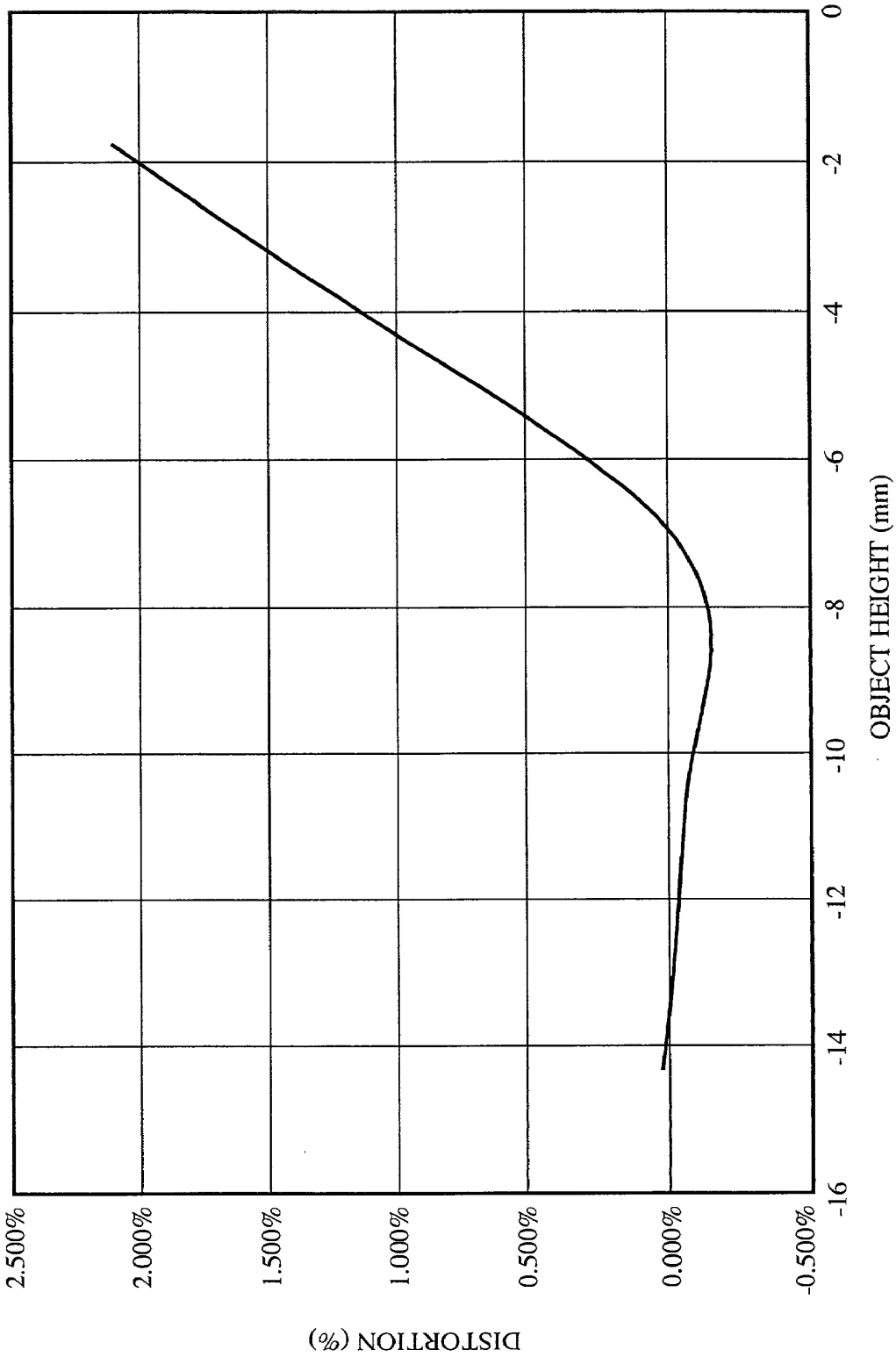

2.500%
2.000%
1.500%
1.000%
0.500%
0.000%
-0.500%
DISTORTION (%)
0
-2
-4
-6
-8
-10
-12
-14
-16
OBJECT HEIGHT (mm)

FIG.55

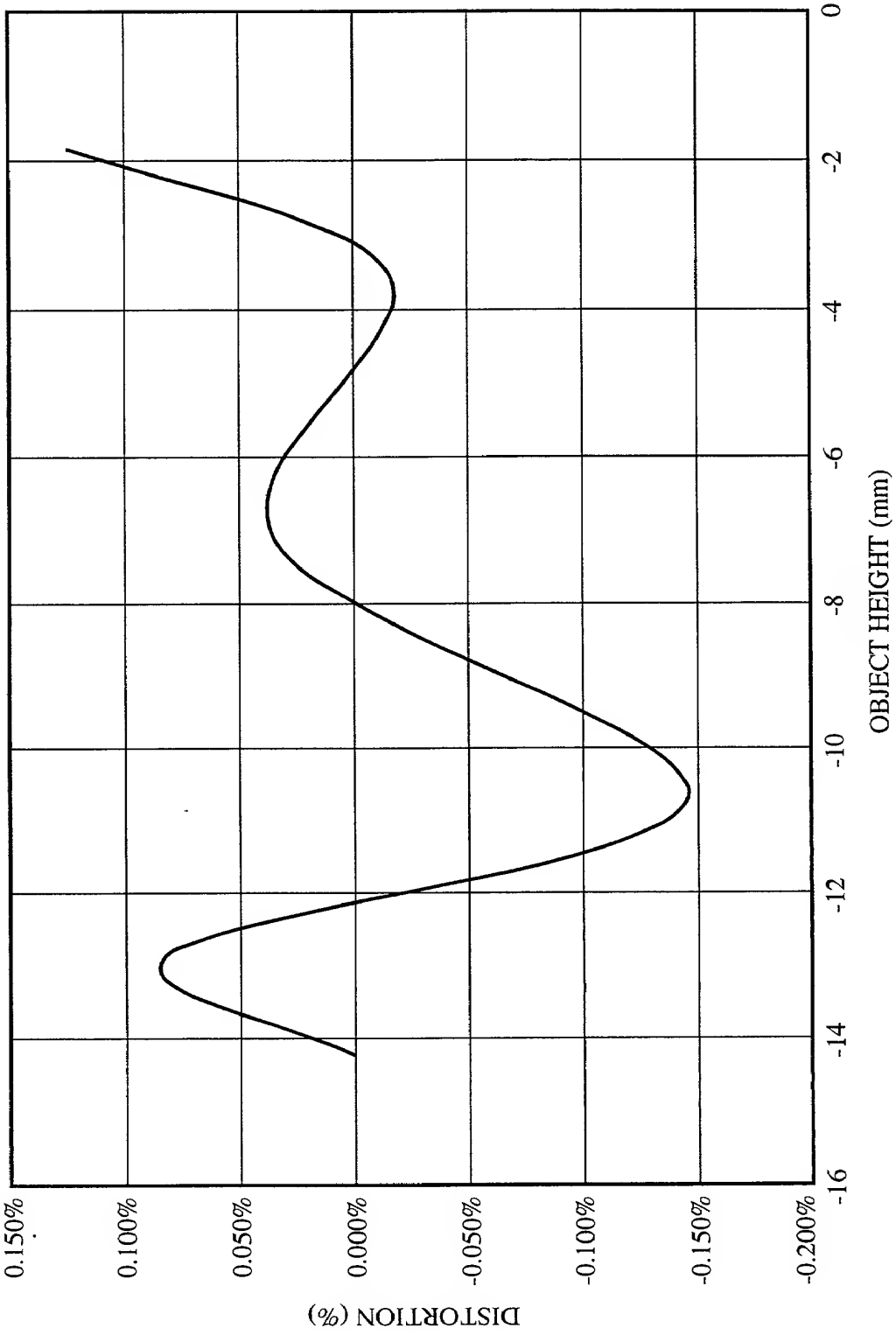

0.150%
0.100%
0.050%
0.000%
-0.050%
-0.100%
-0.150%
-0.200%
DISTORTION (%)
0
-2
-4
-6
-8
-10
-12
-14
-16
OBJECT HEIGHT (mm)

FIG.56B

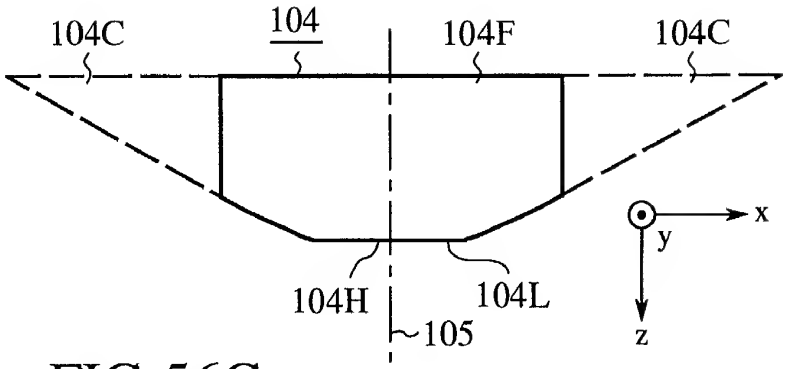


FIG.56A

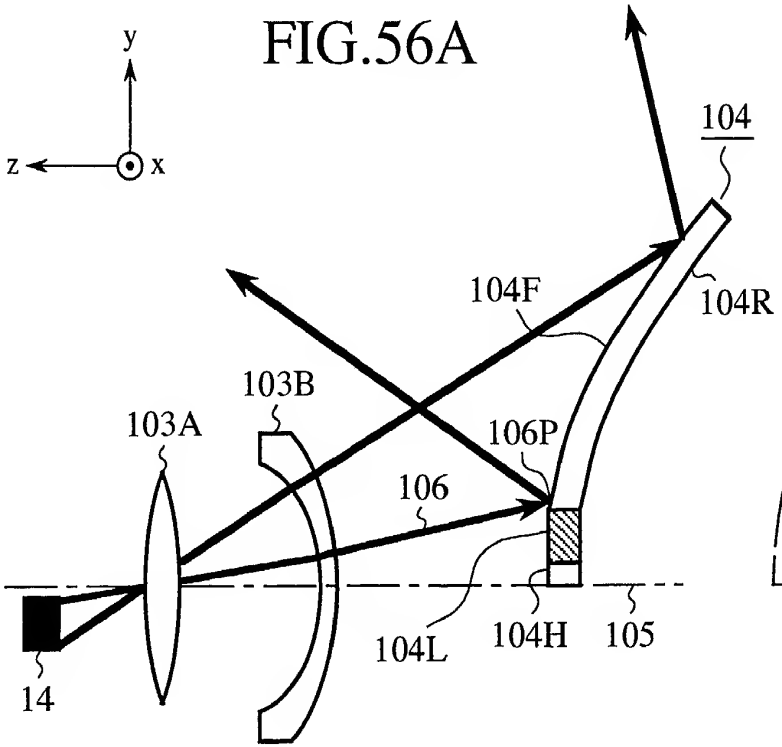


FIG.56C

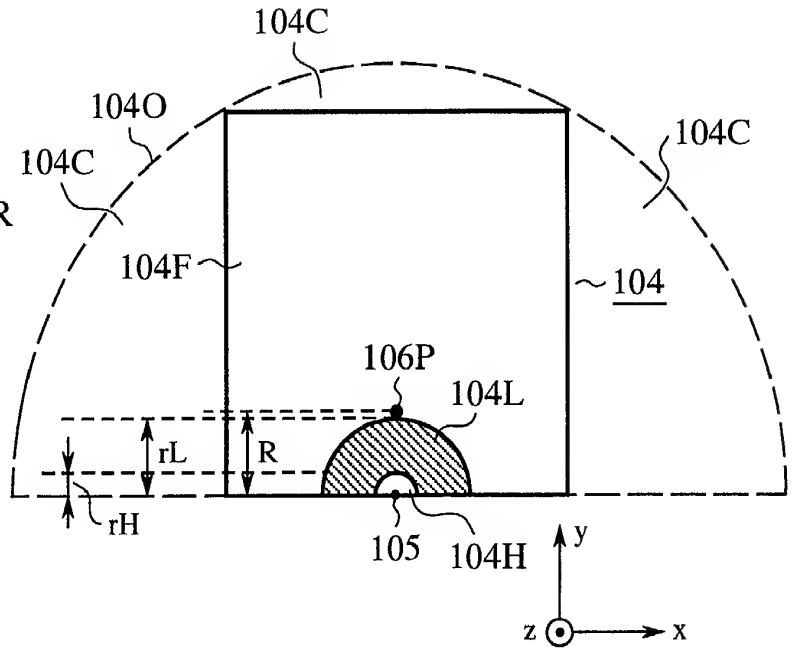


FIG.57A

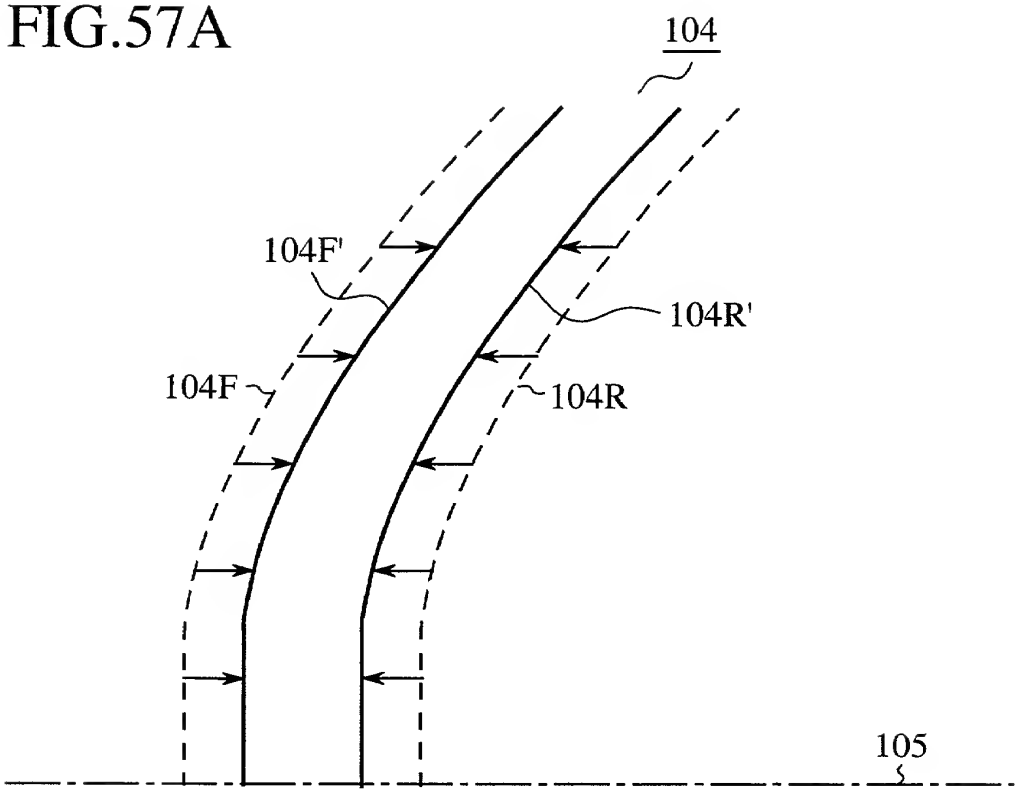


FIG.57B

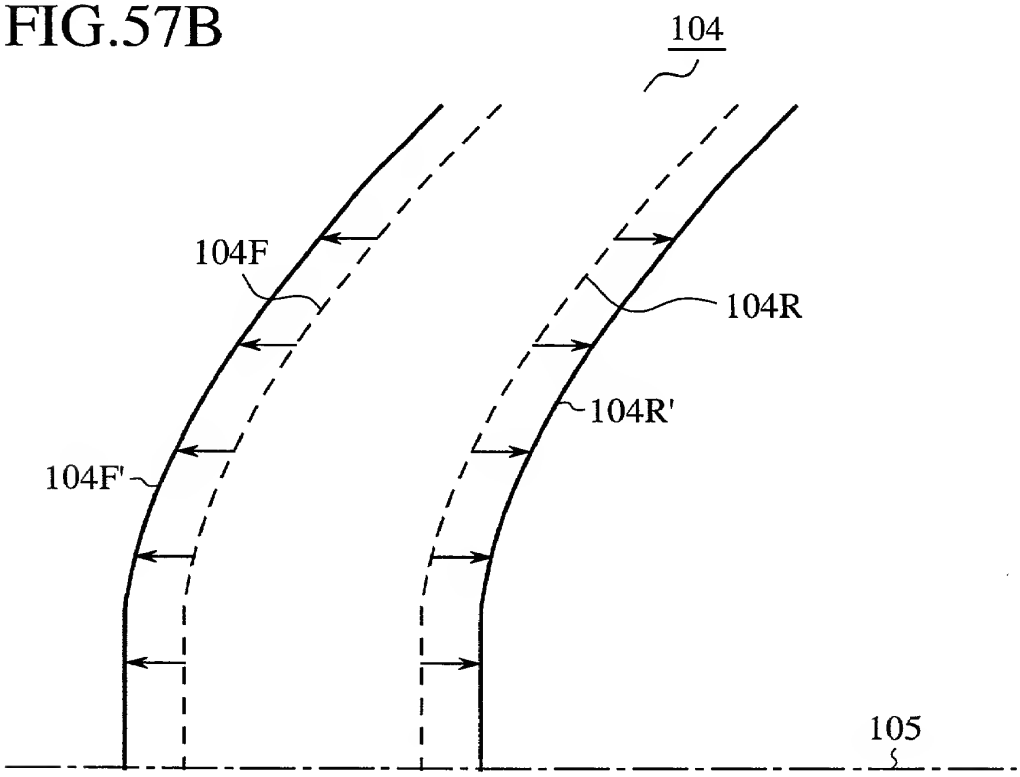


FIG.58A

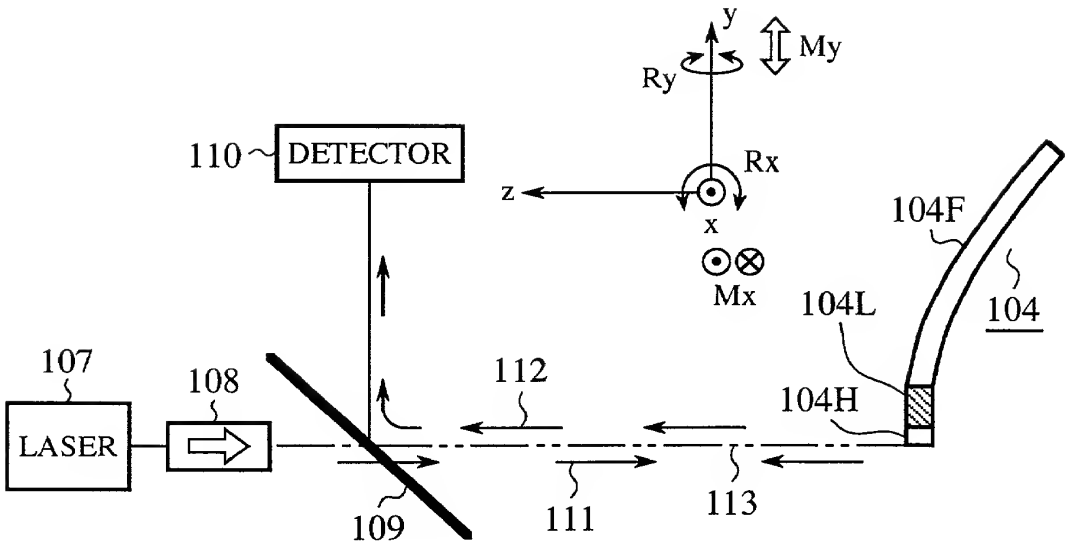


FIG.58B

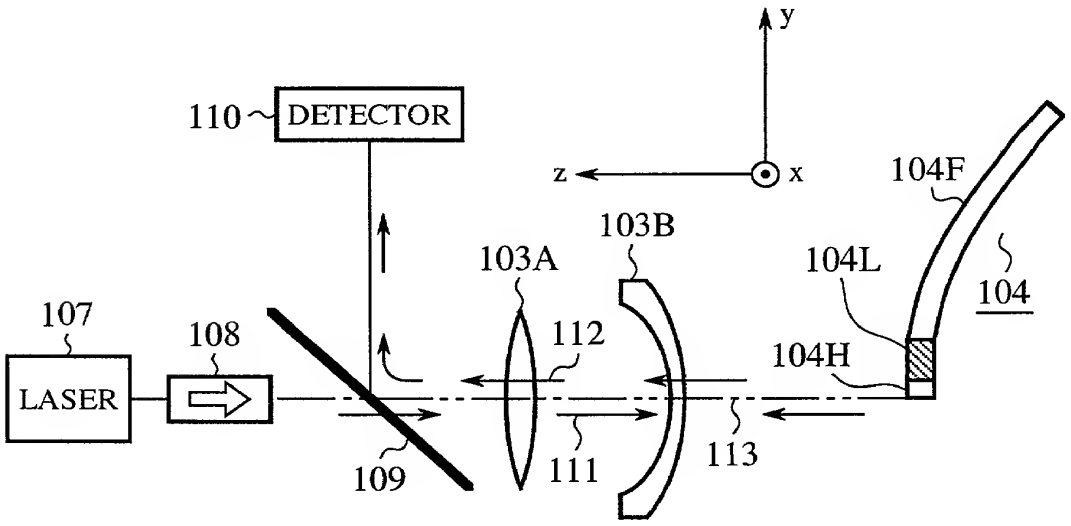


FIG.58C

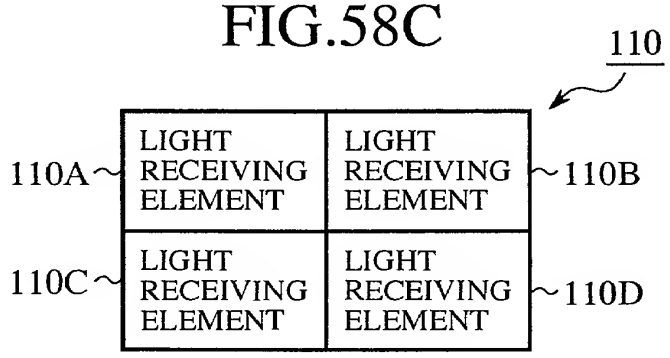


FIG.59

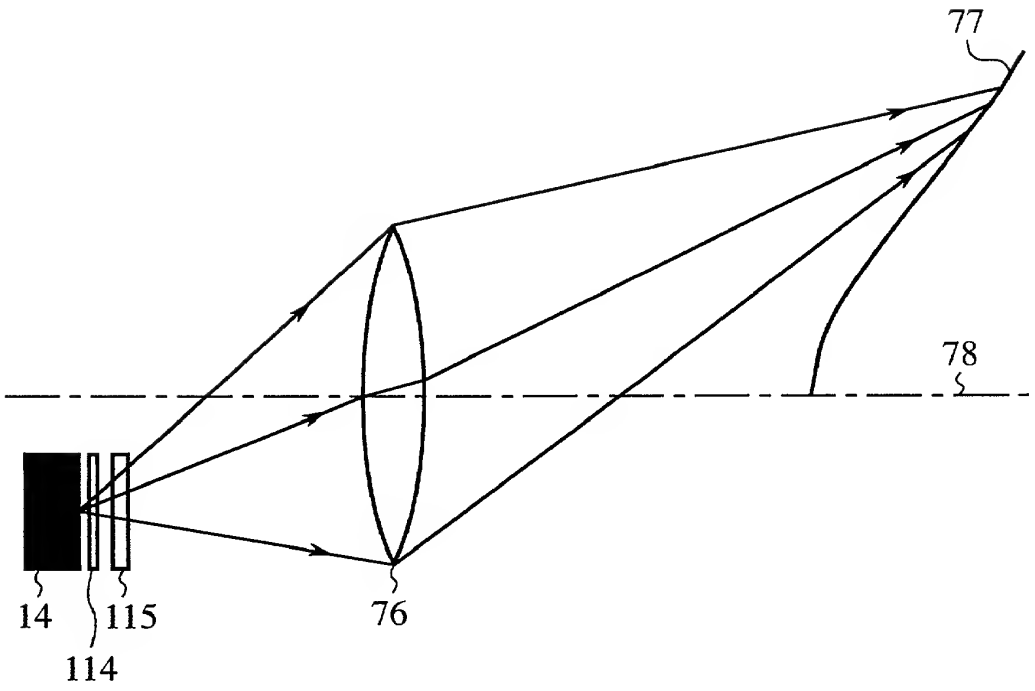


FIG.60A

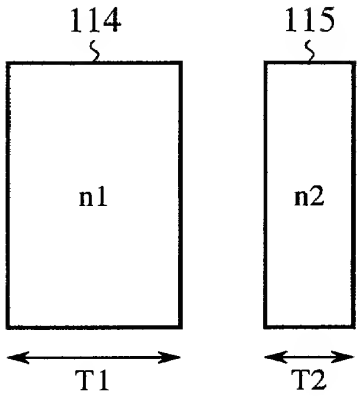


FIG.60B

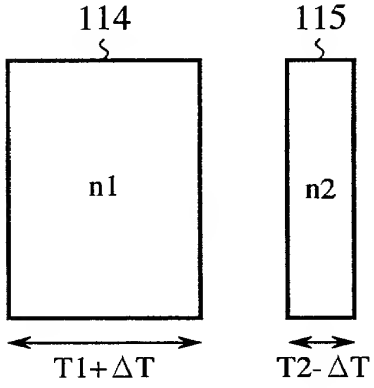


FIG.60C

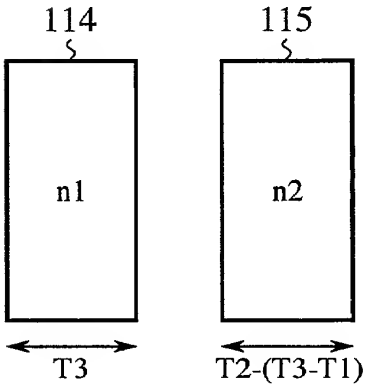


FIG.61

	SURFACE NO.	RADIUS OF CURVATURE (mm)	THICKNESS (mm)	REFRACTIVE INDEX nd	ABBE'S NUMBER νd
	1	∞	16.968		
	2	∞	4.5	1.487488	70.4
	3	∞	10		
stop	4	∞	0		
	5	-32.67553228	2.2	1.755200	27.5
	6	12.58063824	3	1.743300	49.3
a1	7	-52.90163133	0.2		
	8	61.0404767	4.4	1.729160	54.7
	9	-11.15923642	0.75	1.805181	25.5
	10	-76.60896233	15.79661203		
	11	-124.8193679	7	1.805181	25.5
	12	-38.93002102	0.2		
	13	-443.3986638	7	1.805181	25.5
	14	-52.34621034	0.2		
	15	79.93164049	7	1.805181	25.5
	16	-309.0156537	5.05		
	17	-154.4333819	20	1.696802	55.5
	18	-23.63819092	5.65	1.805181	25.5
	19	-72.50920655	0.1		
	20	-135.8874032	1.3	1.806100	33.3
	21	19.12119784	6.033332559	1.622994	58.1
	22	47.30795139	10.38100593		
	23	-17.33118223	1	1.805181	25.5
	24	-107.7455893	0.2		
	25	6275.660982	13.85243075	1.496997	81.6
	26	-28.5622612	0.3	1.517900	52.3
a2	27	-28.56225984	220		
a3	28	100.7024021	-180		mirror
	29	∞	230		mirror
	30	∞	0		

ASPHERICAL SURFACE COEFFICIENT

SURFACE NO.	7(a1)	27(a2)
k	-4.32940673132E+17	-2.28341058574E-01
A	2.12269026040E-05	6.27190024566E-07
B	3.29700420778E-08	1.37772750580E-10
C	-8.29121655424E-10	-2.97585526938E-12
D	8.20349889370E-12	4.49026971395E-15

SURFACE NO.	28(a3)
k	-5.53539236314
A	-1.01852653476E-08
B	3.39532791265E-13
C	-7.71671397273E-18
D	8.40279684117E-23

FIG.62

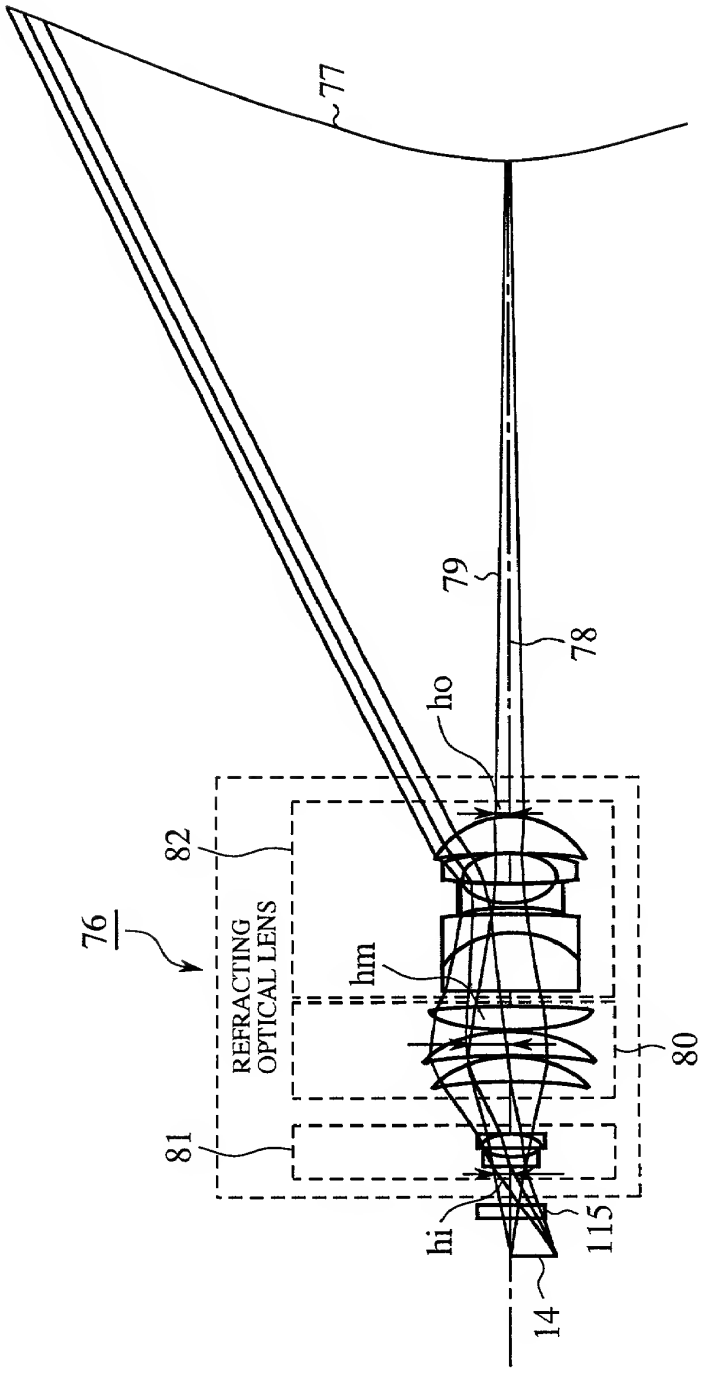


FIG.63A

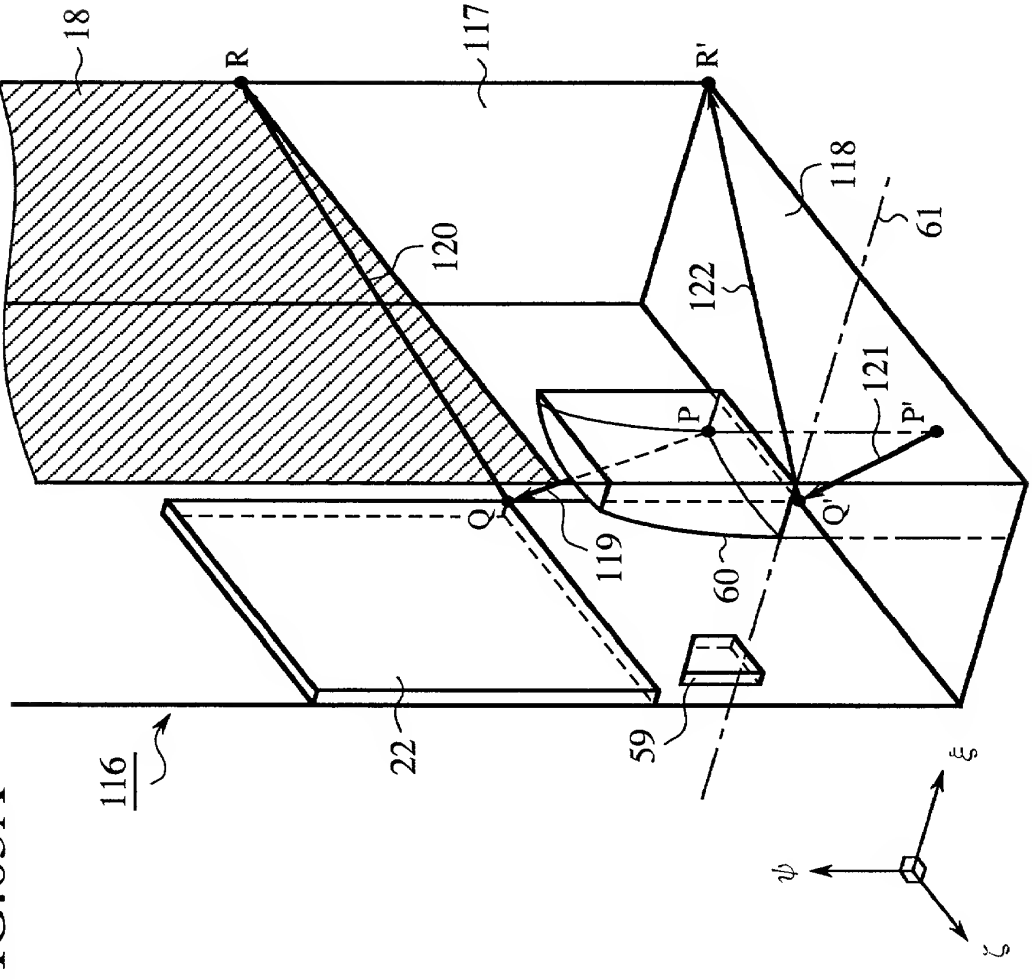
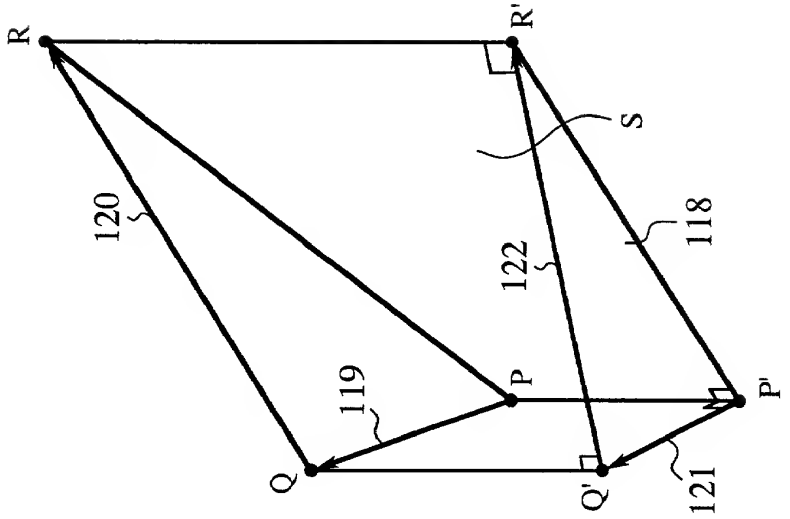


FIG.63B



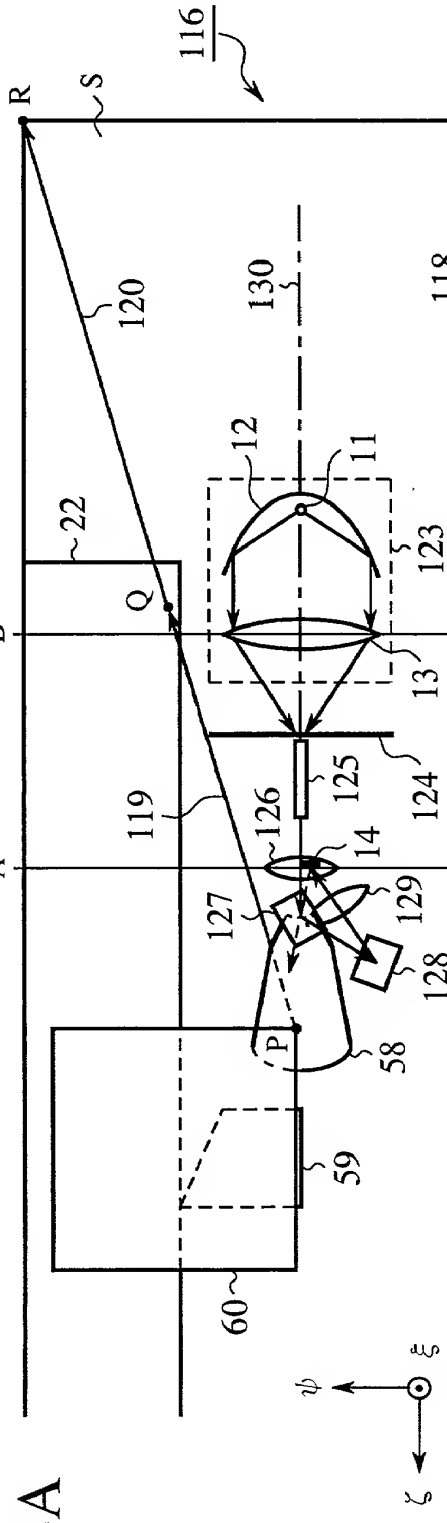


FIG.64A

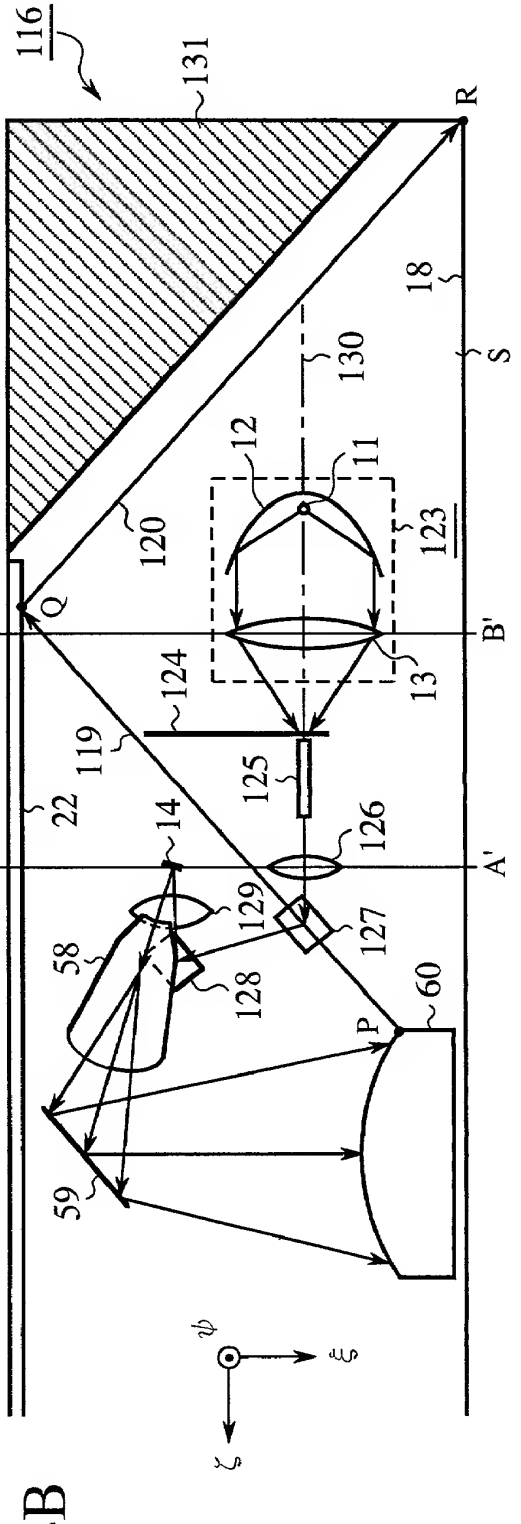


FIG.64B

FIG.65A

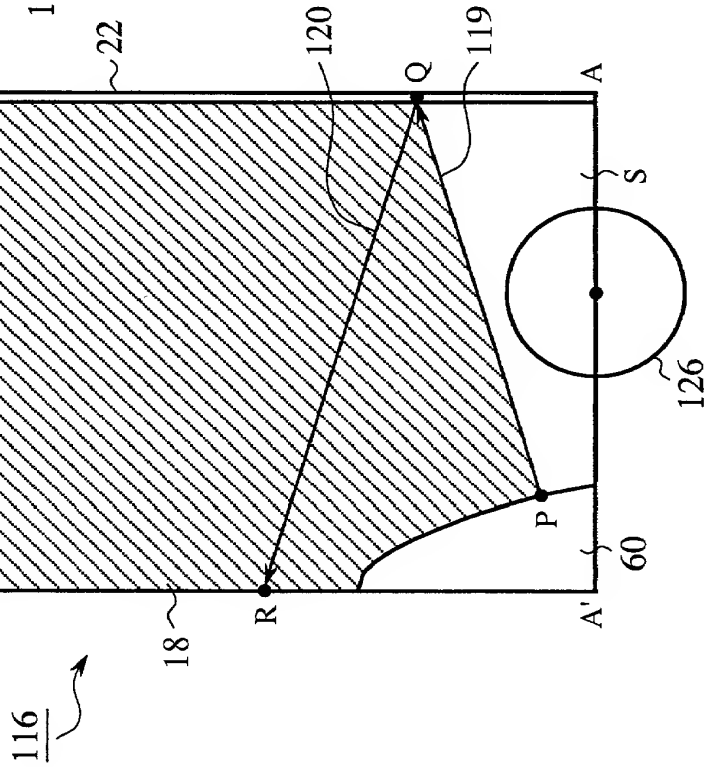


FIG.65B

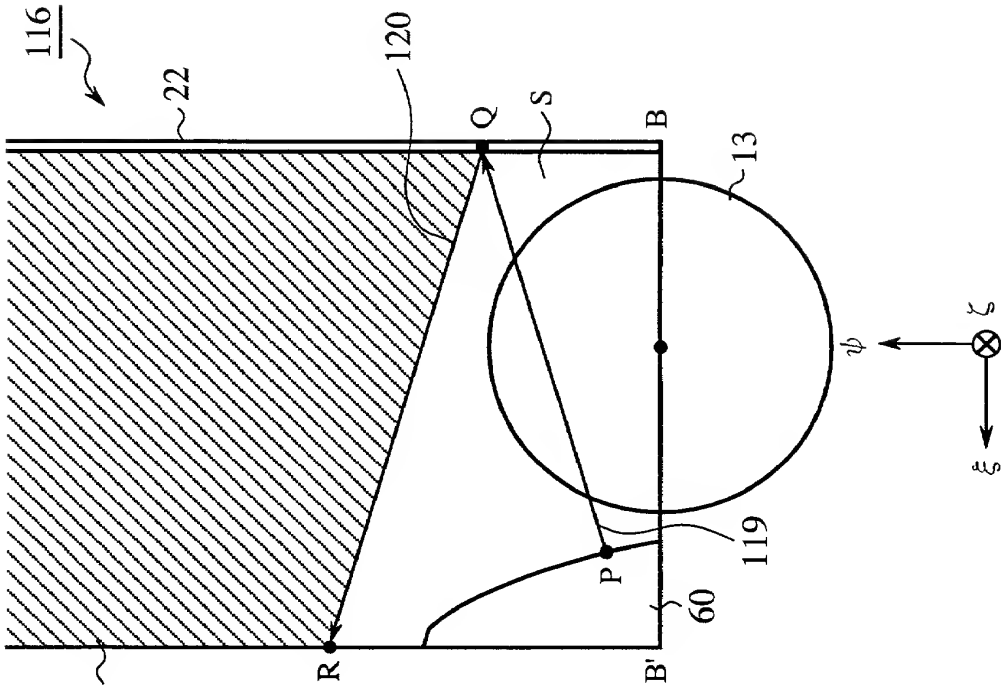


FIG.66

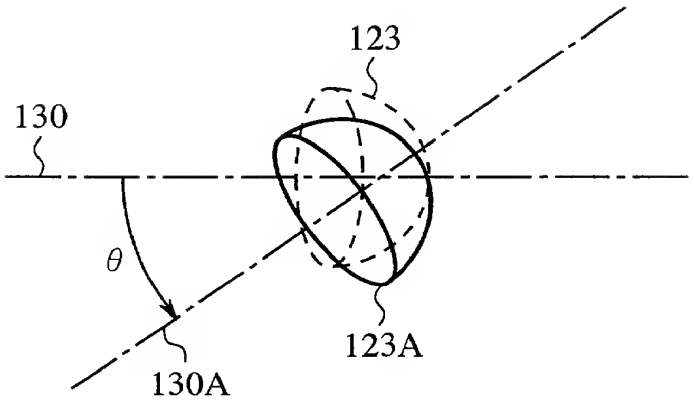


FIG.67A

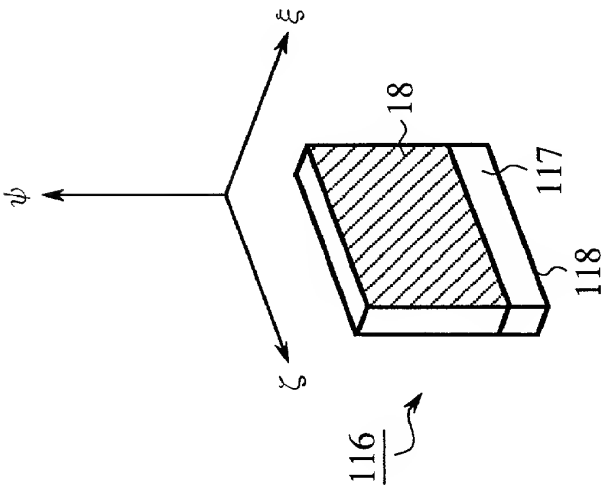


FIG.67B

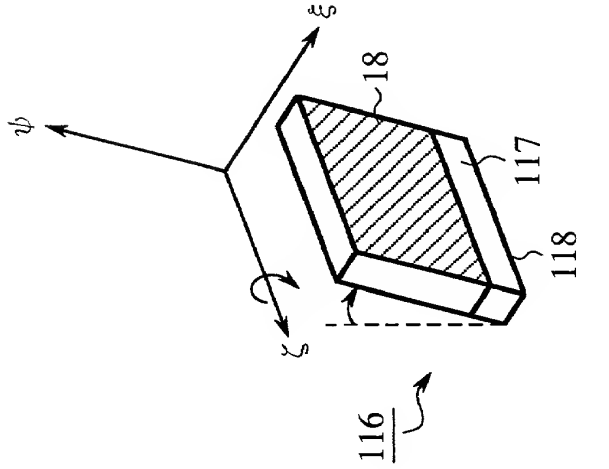


FIG.67C

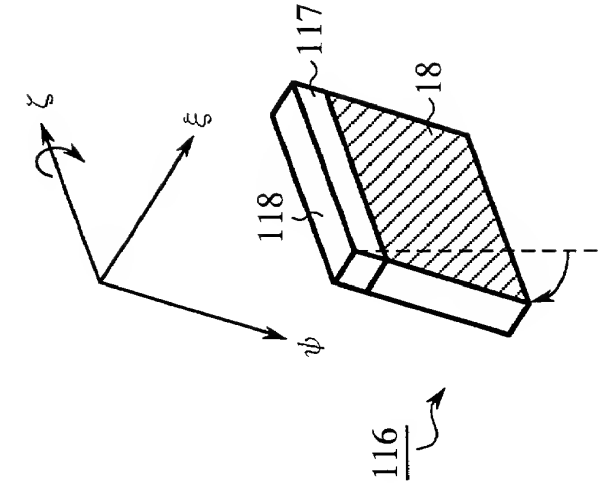
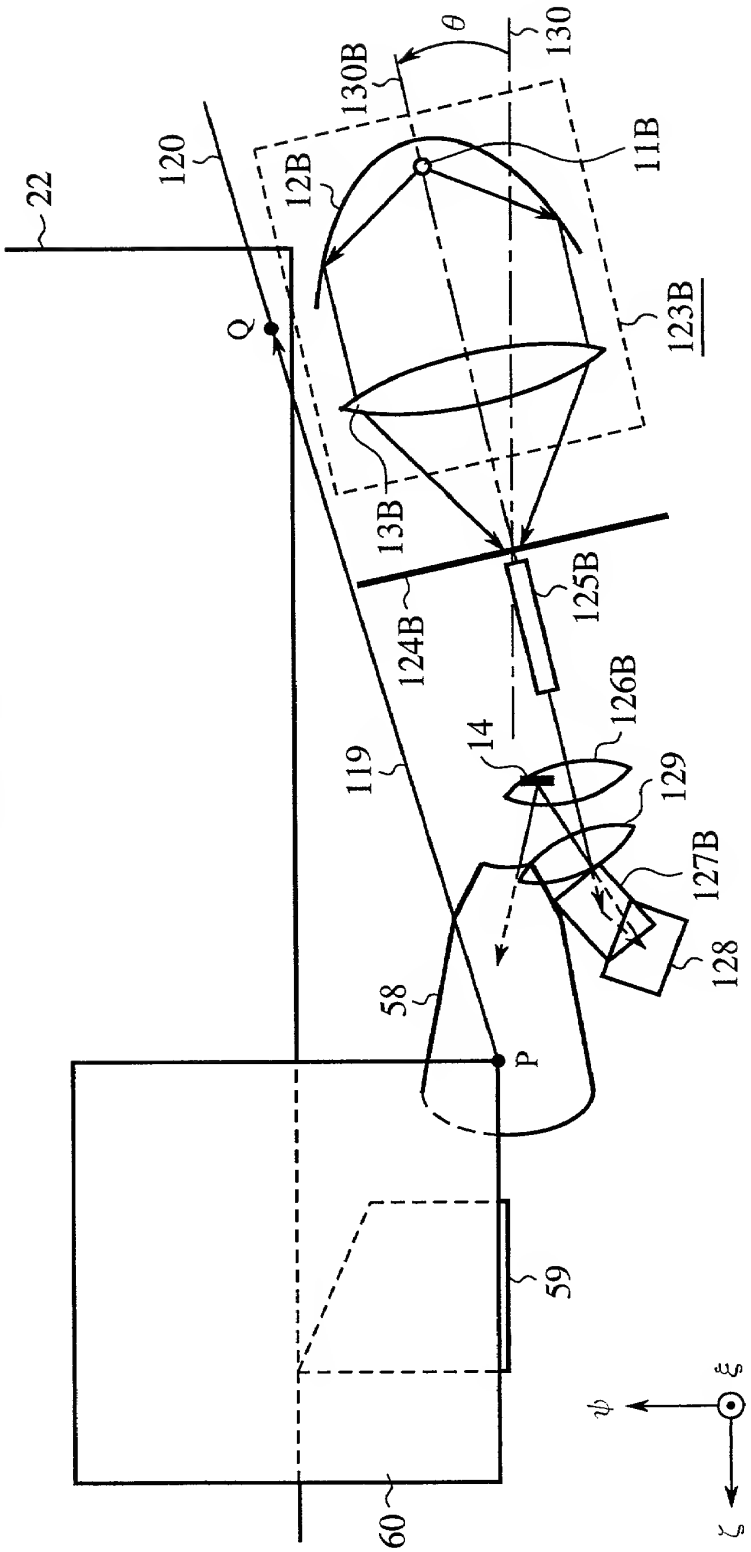


FIG.68


22
120
Q
12B
130B
θ
130
11B
123B
13B
125B
124B
126B
14
119
129
127B
128
58
P
59
60
ψ
ξ
ζ

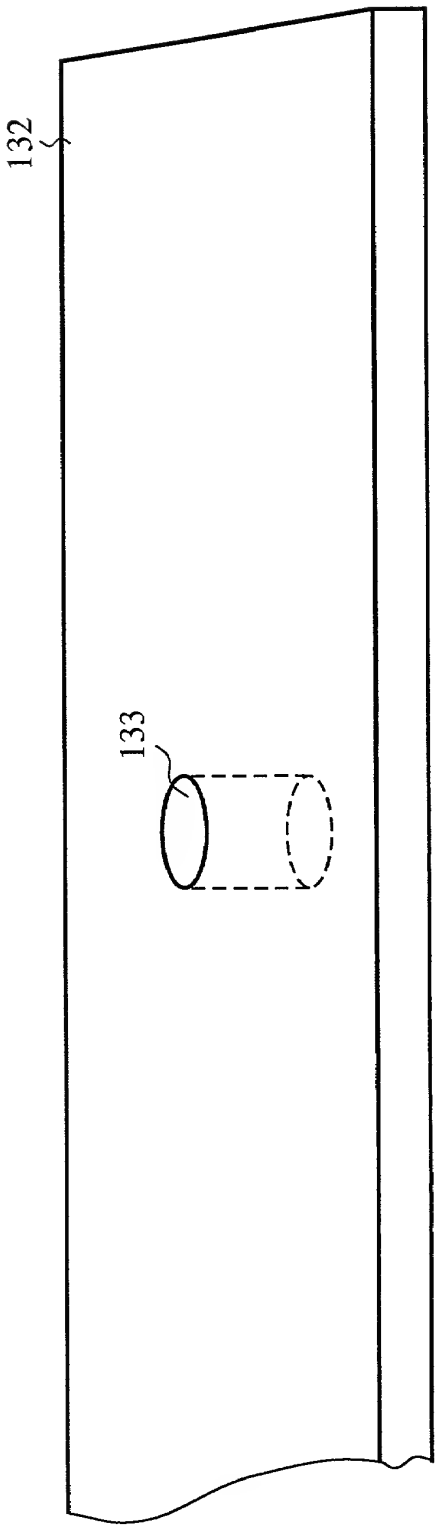


FIG.69

FIG.70A

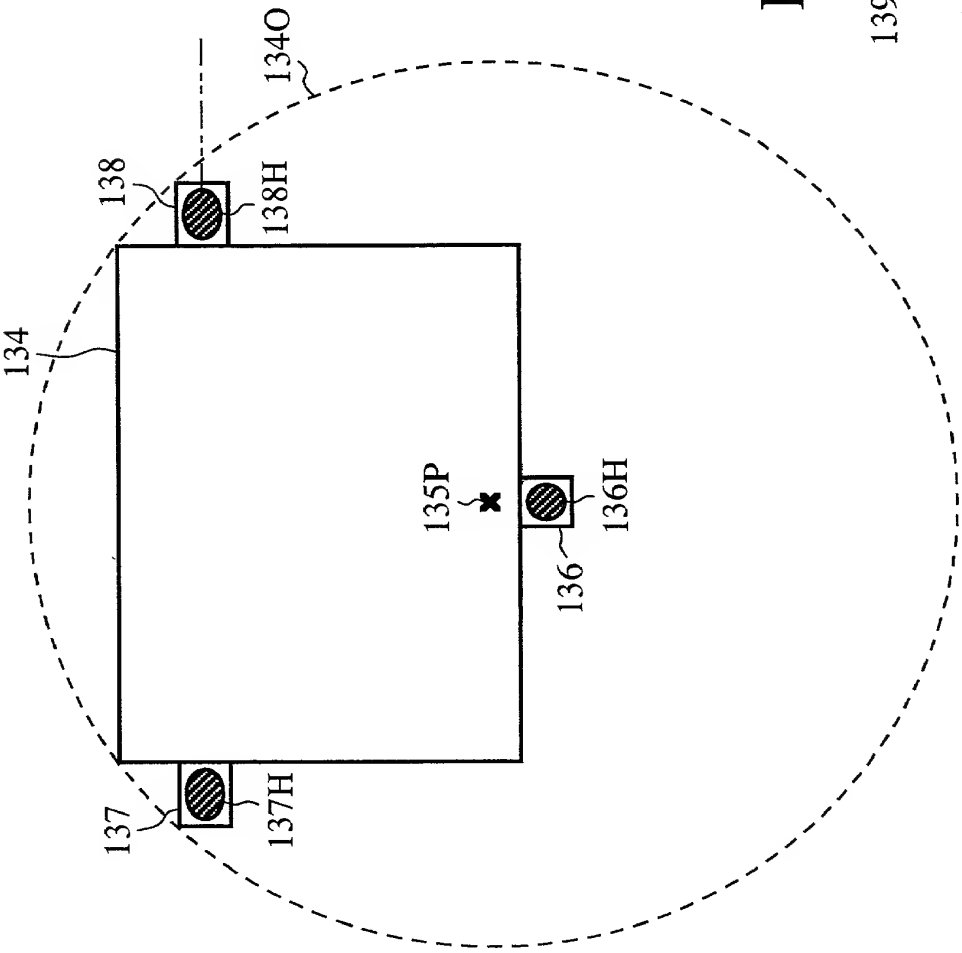


FIG.70B

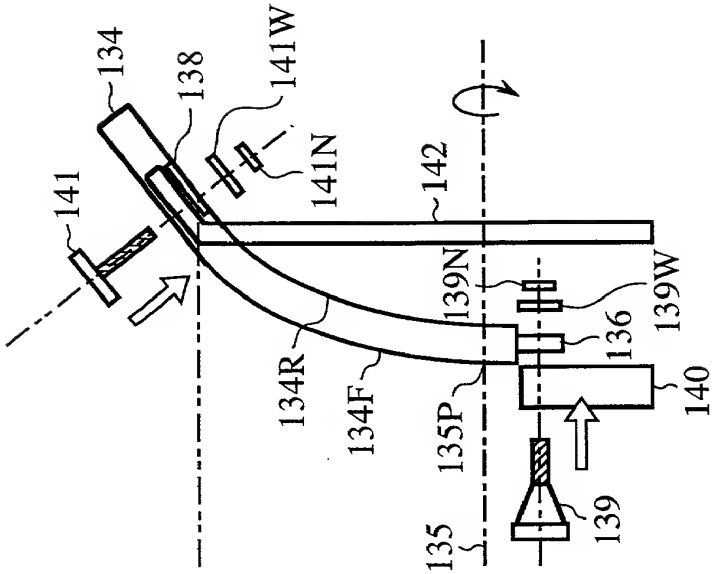


FIG.70C

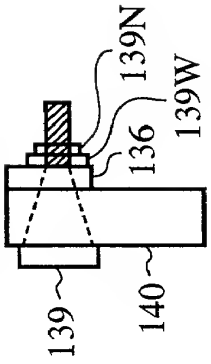


FIG.71A

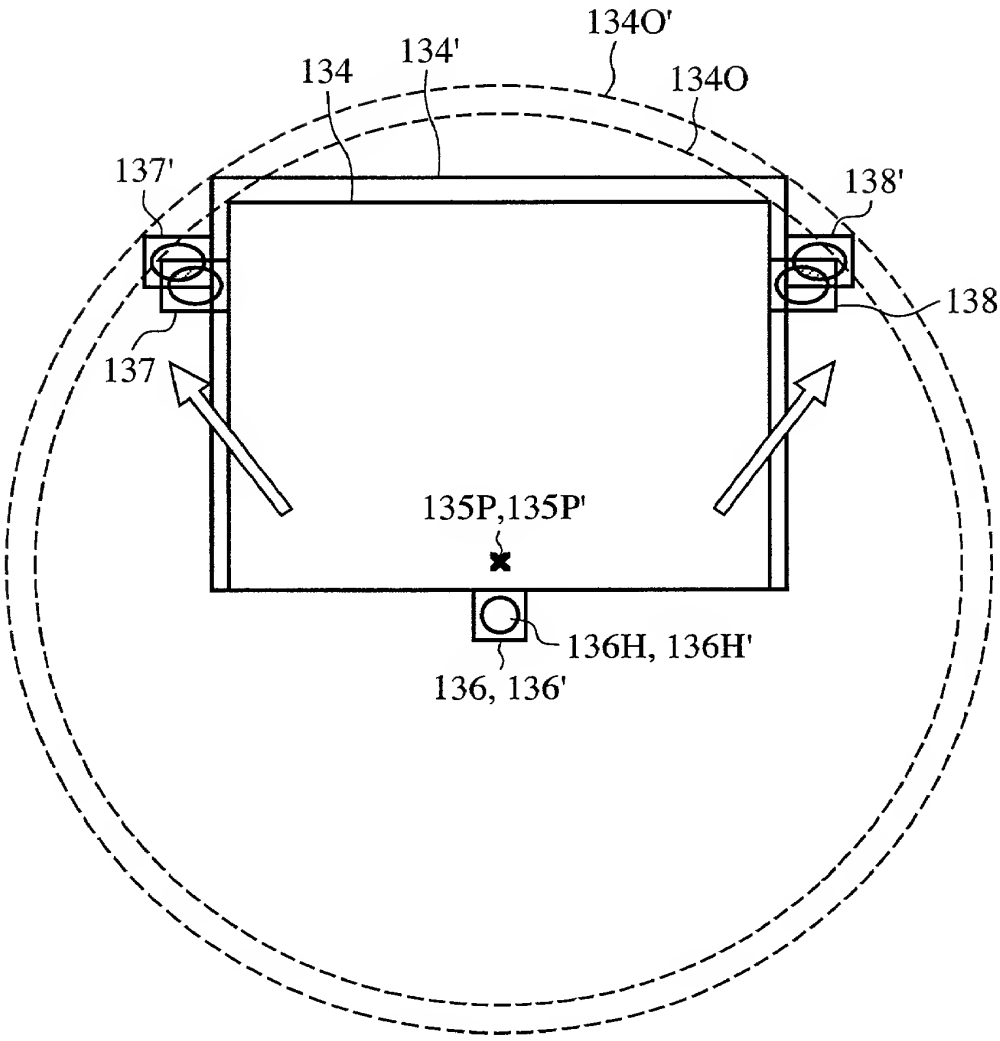


FIG.71B

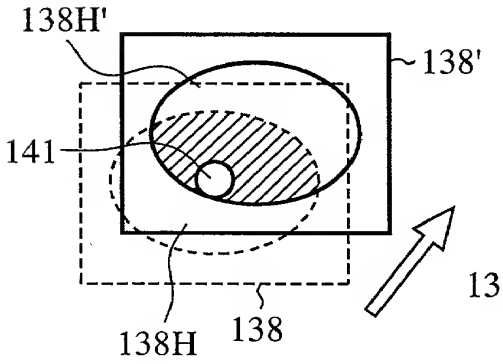


FIG.71C

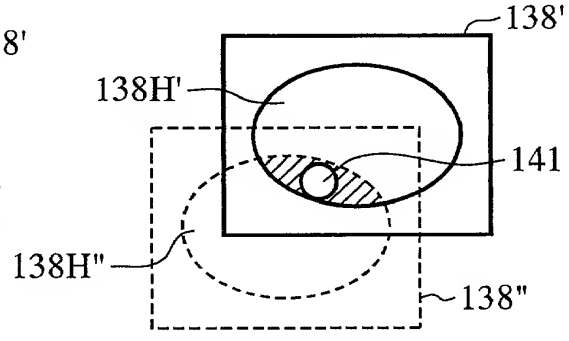


FIG.72A

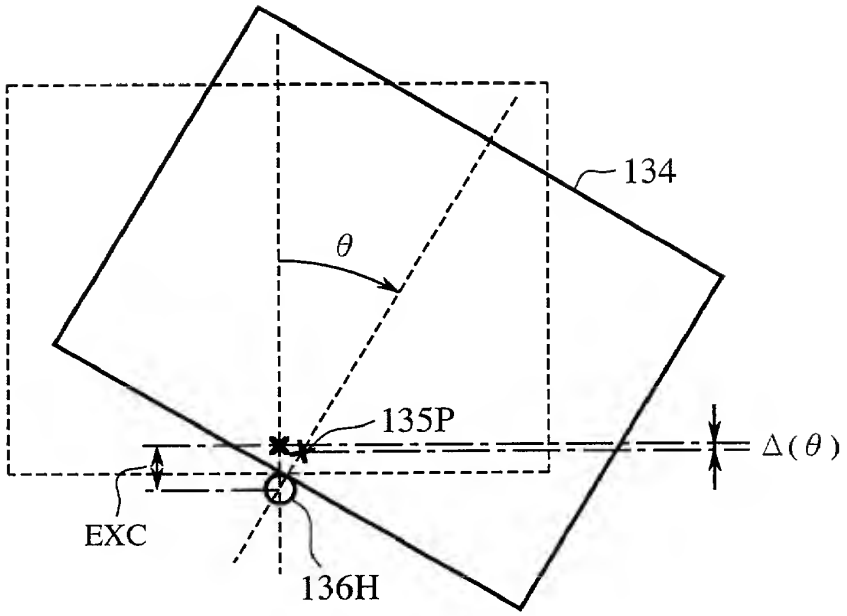


FIG.72B

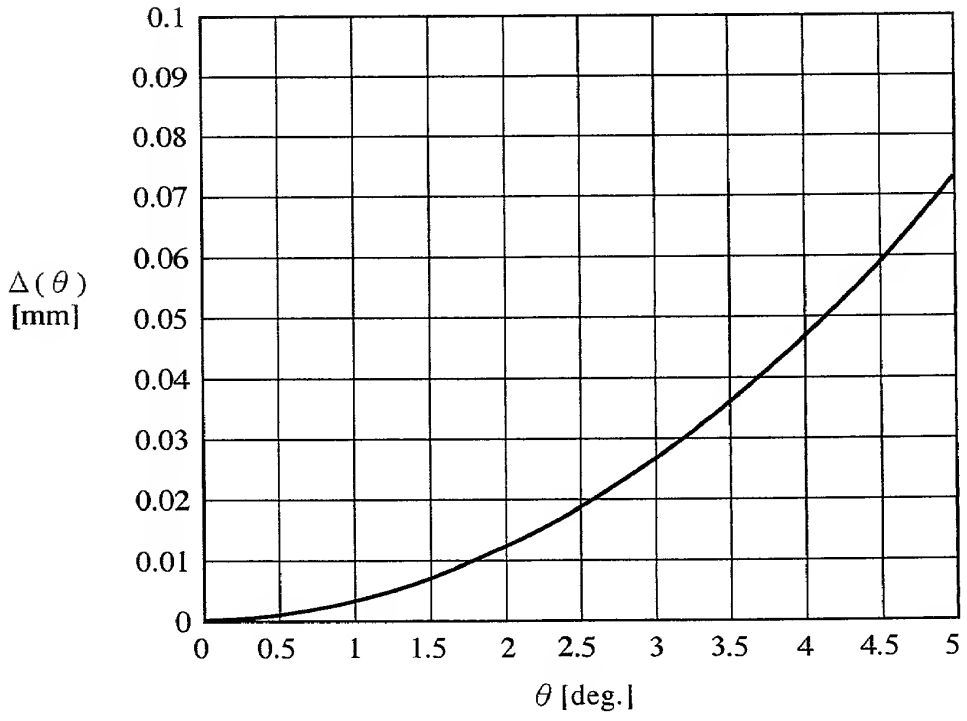


FIG.73A

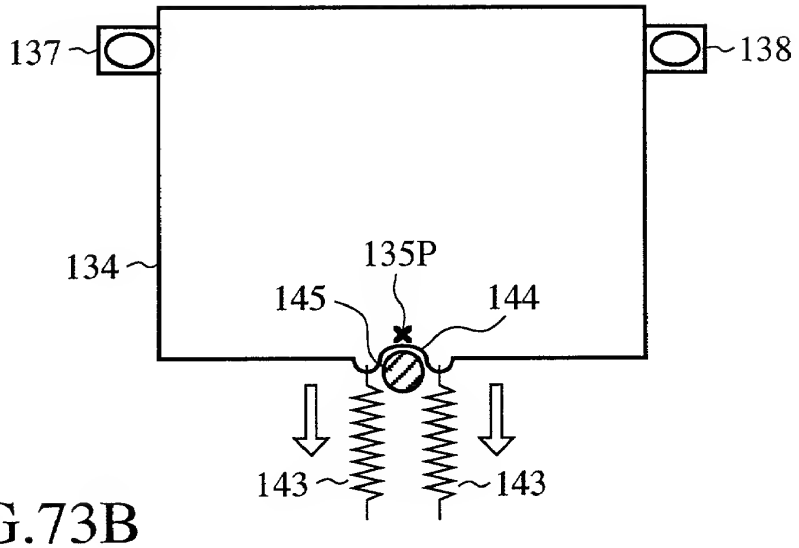


FIG.73B

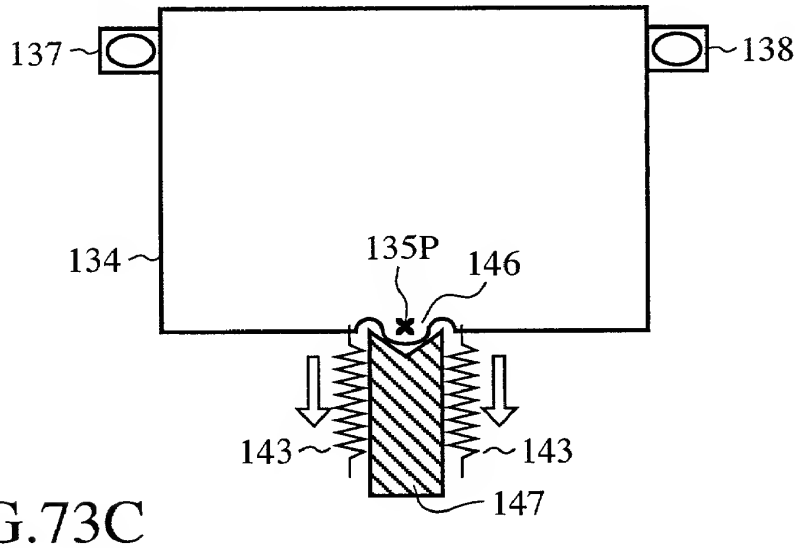


FIG.73C

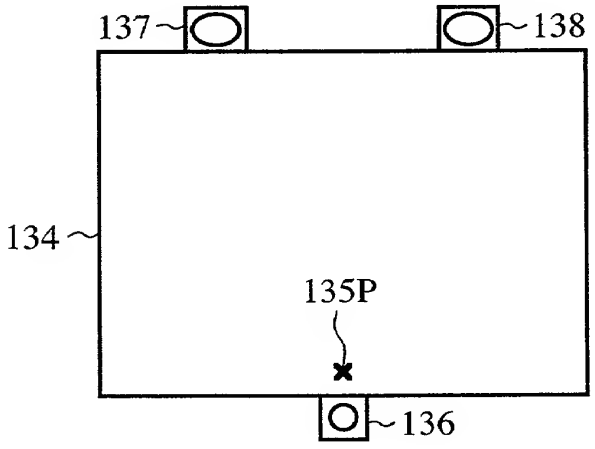


FIG.74

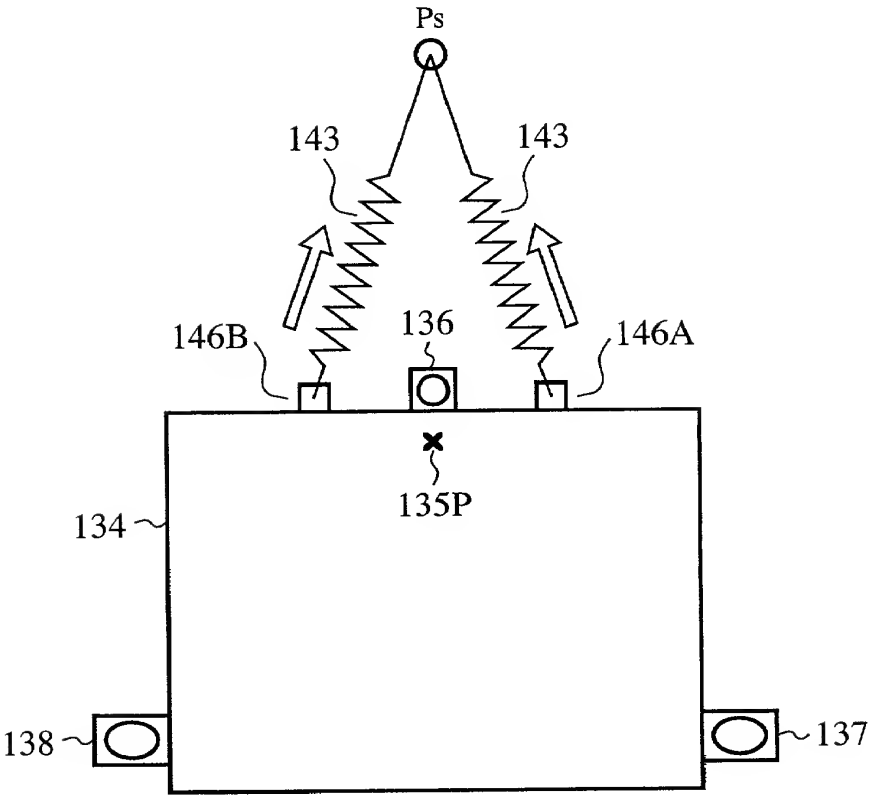


FIG.75

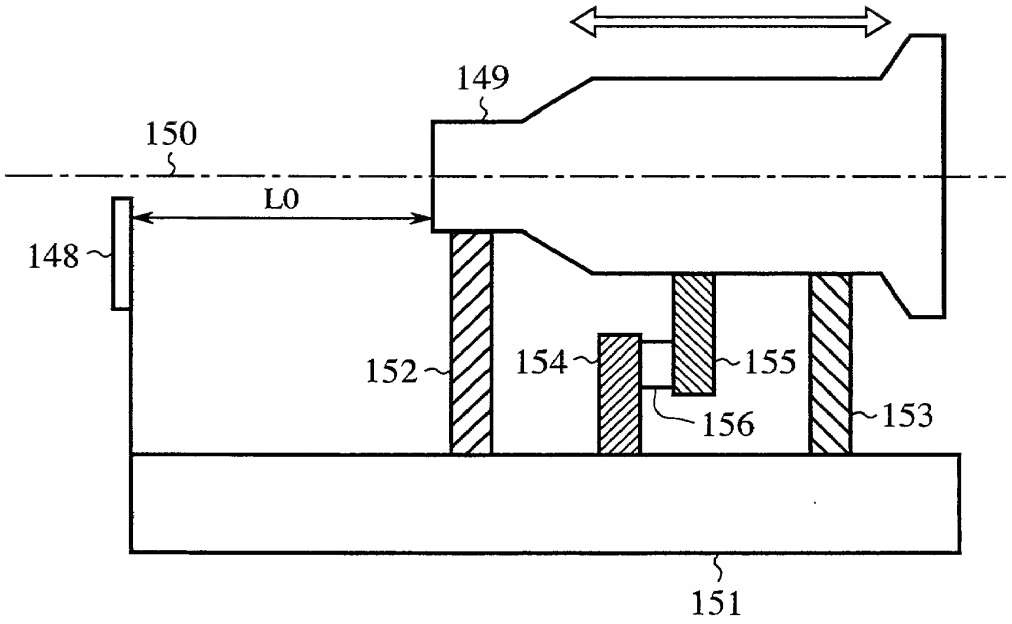


FIG.76

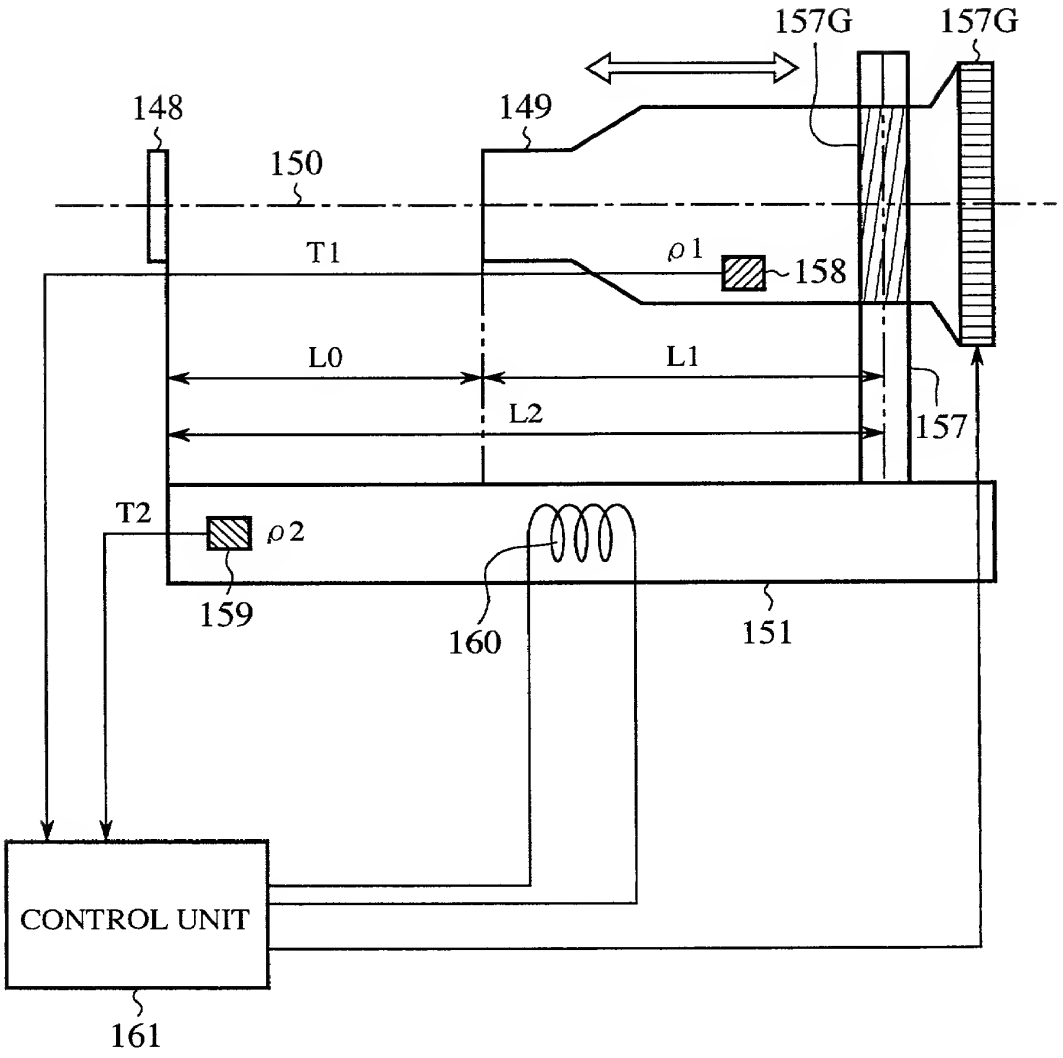

157G
157G
148
149
150
T1
ρ1
158
L0
L1
L2
157
T2
ρ2
159
160
151
CONTROL UNIT
161

FIG.77A

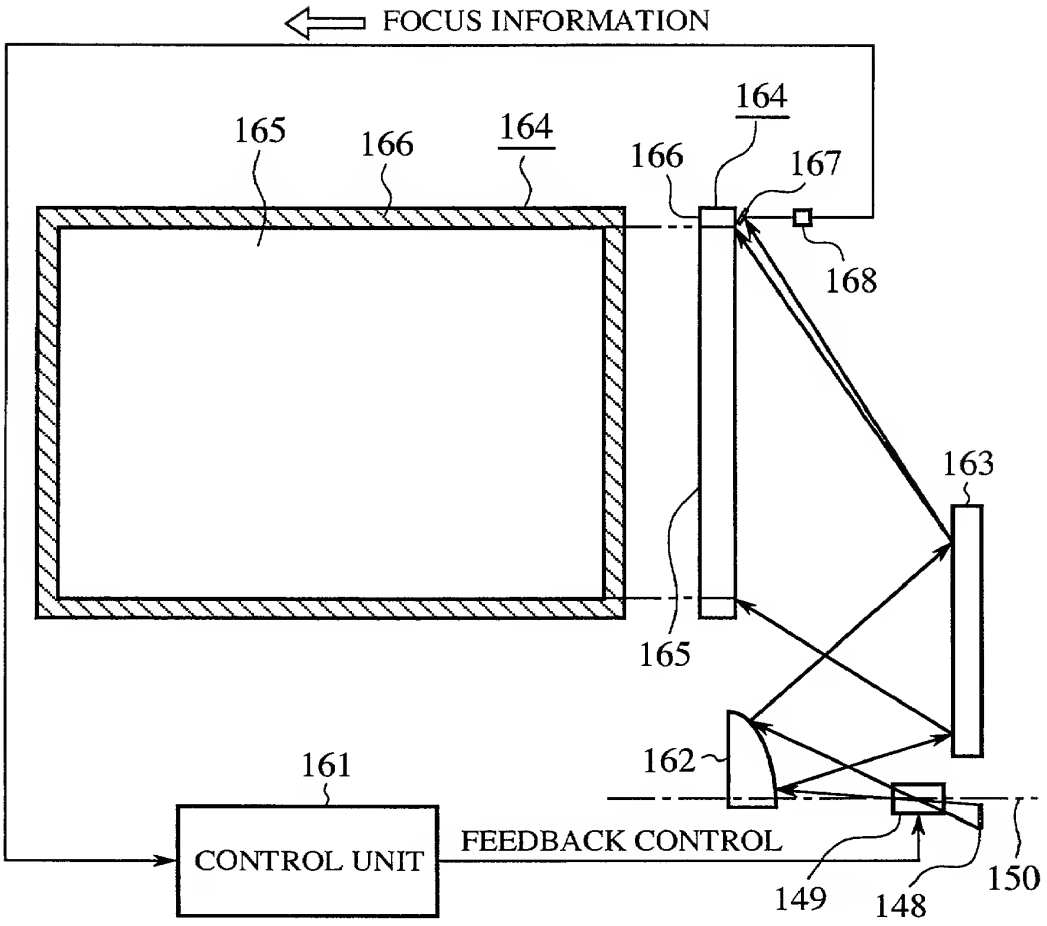


FIG.77B

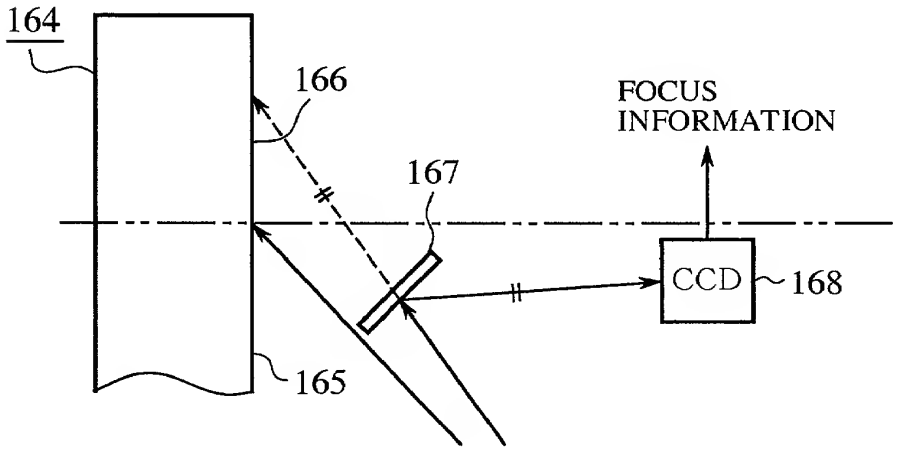


FIG.78A

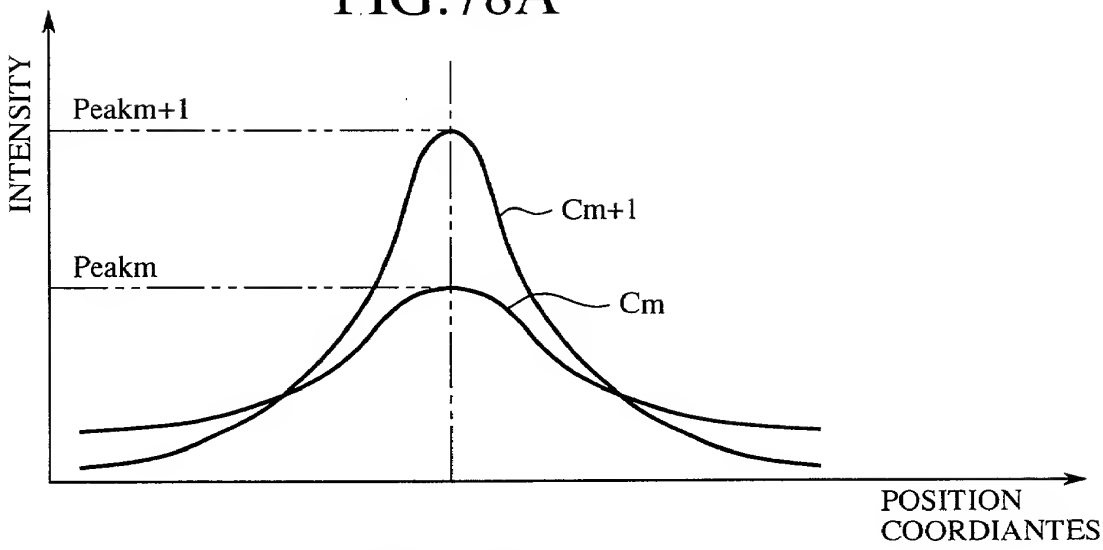


FIG.78B

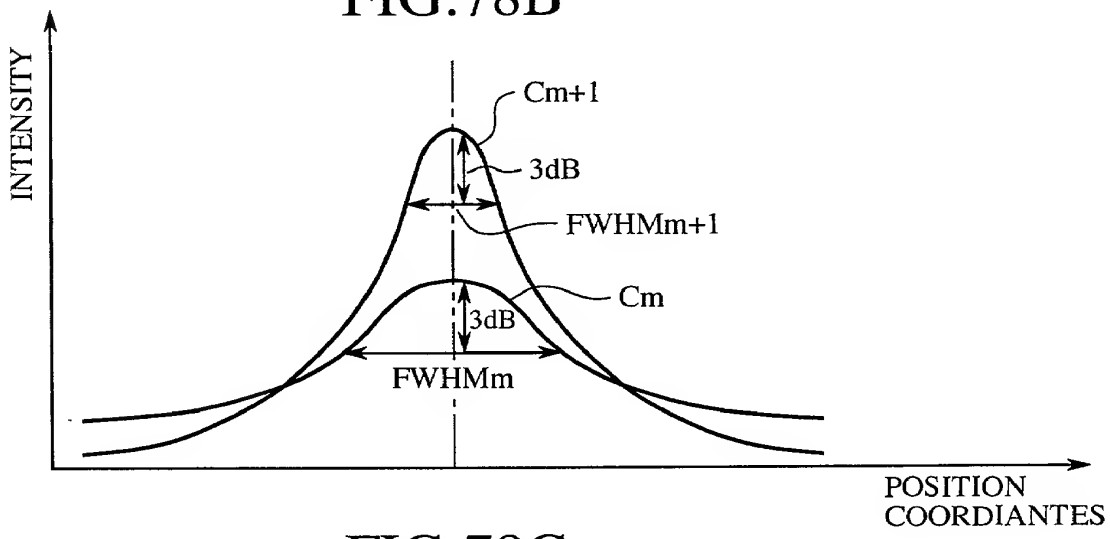


FIG.78C

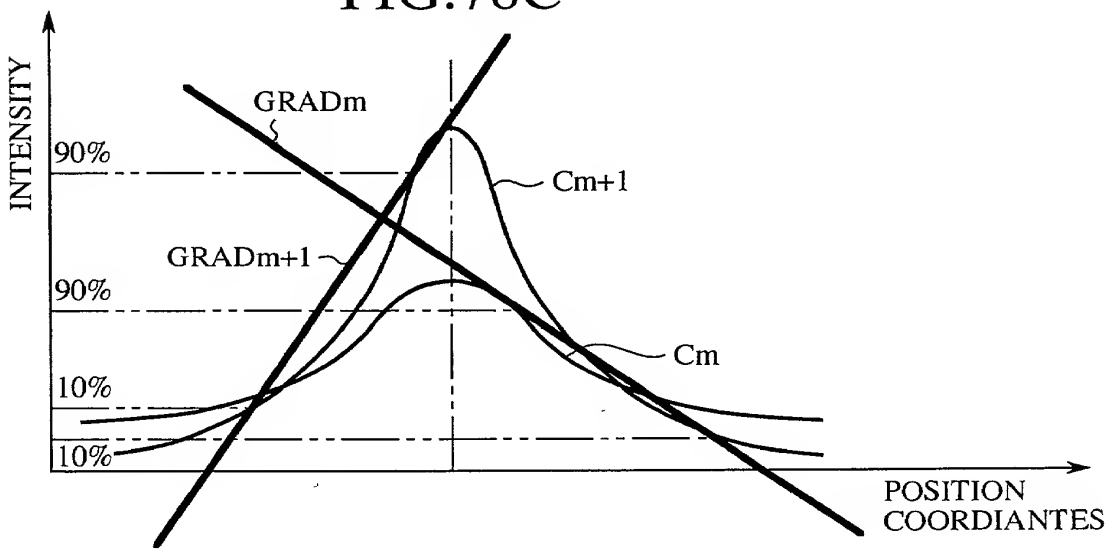


FIG.79

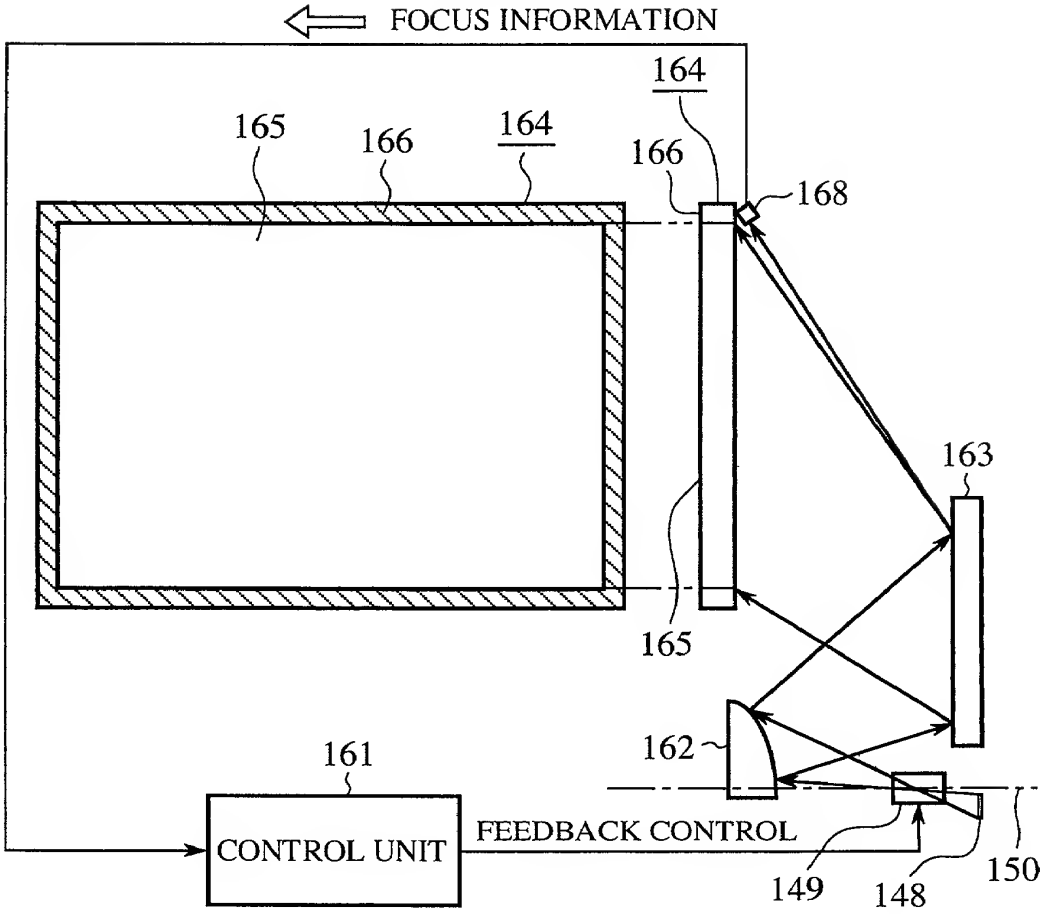

FOCUS INFORMATION
164
165
166
164
166
168
163
165
162
161
CONTROL UNIT
FEEDBACK CONTROL
149
148
150

FIG.80

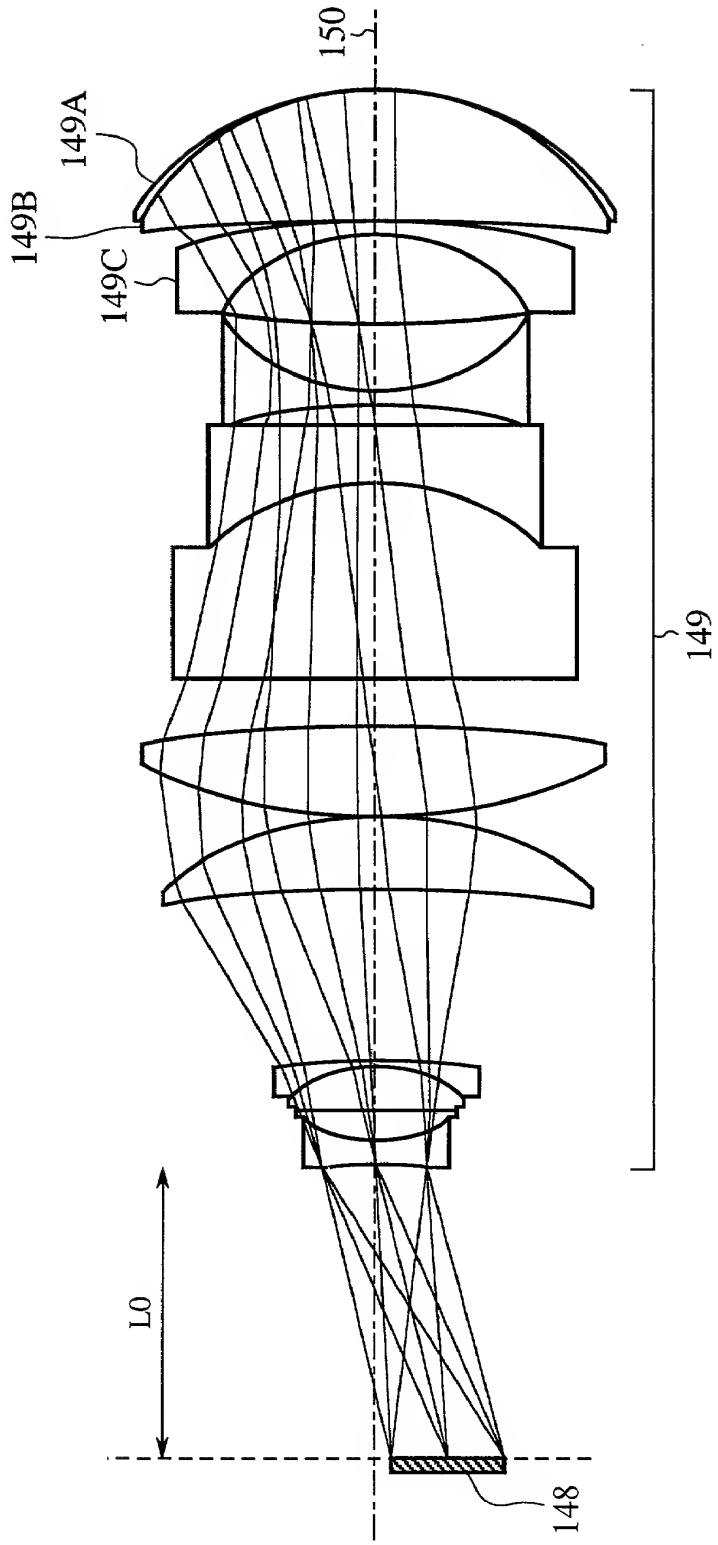


FIG.81

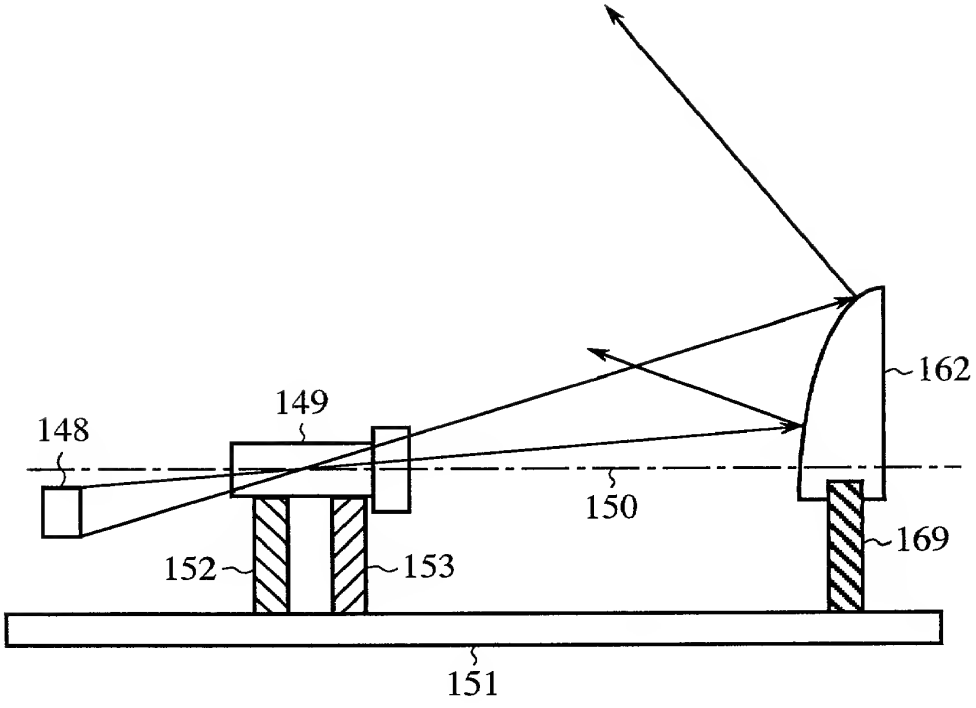


FIG.82A

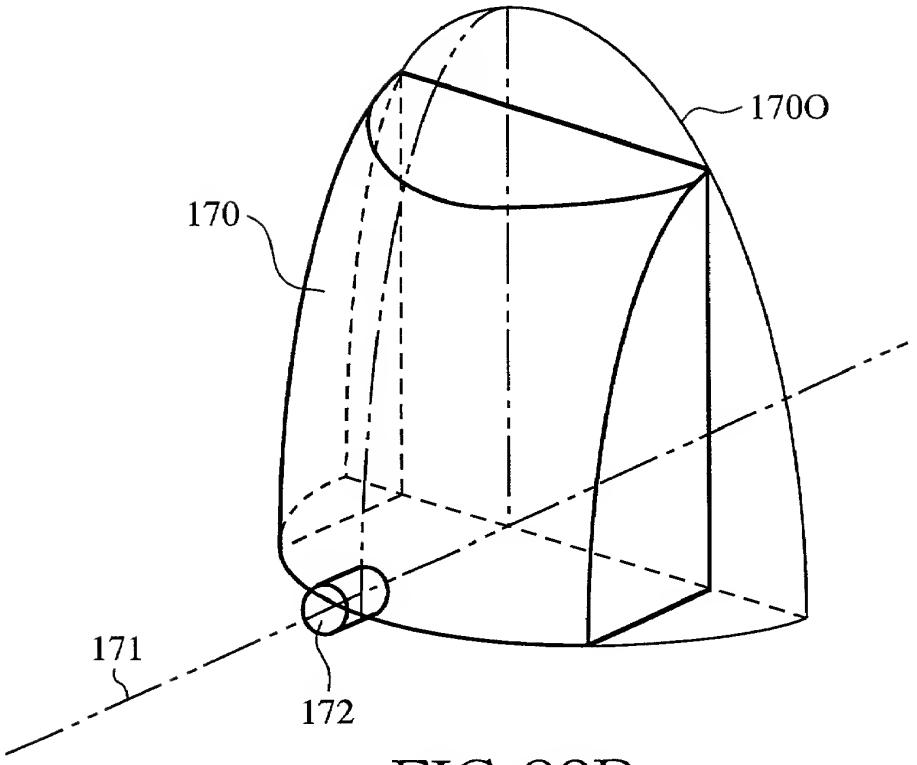


FIG.82B

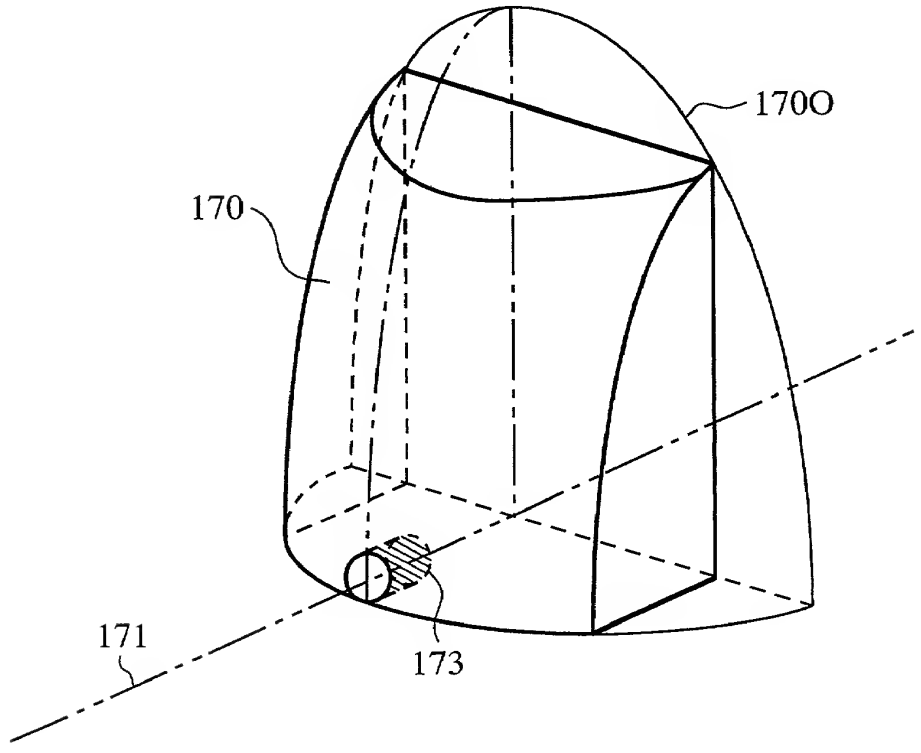
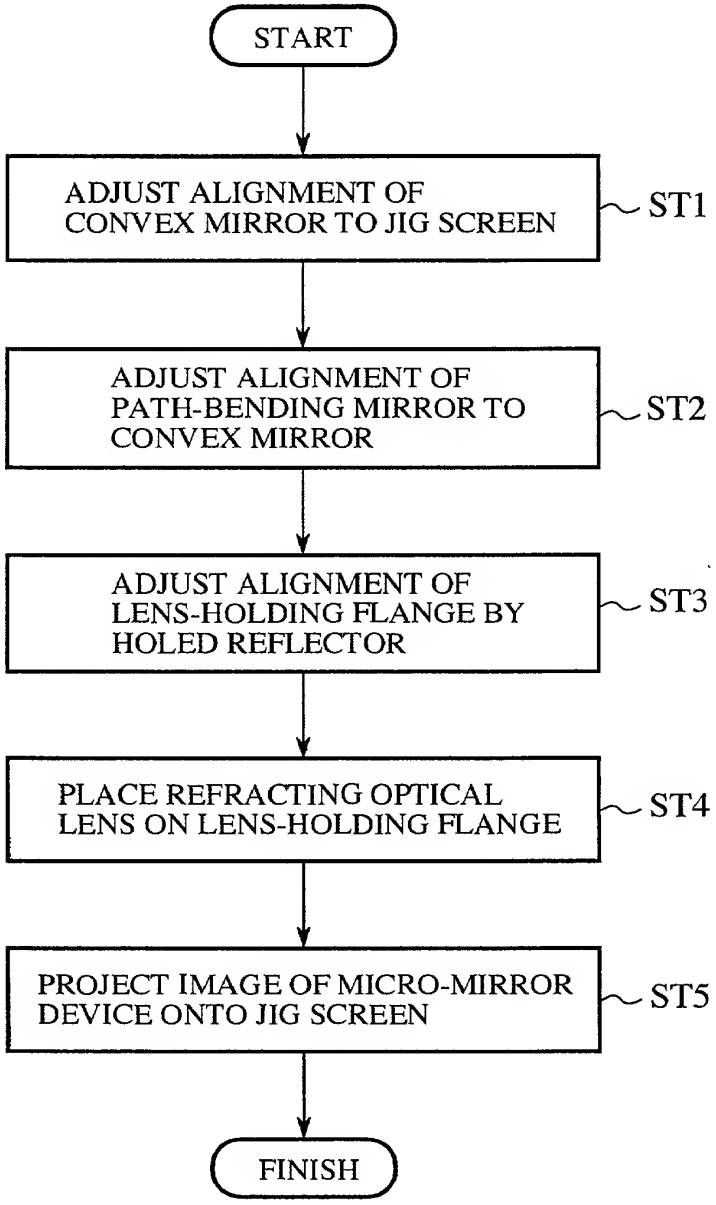


FIG.83


START
ADJUST ALIGNMENT OF CONVEX MIRROR TO JIG SCREEN
ST1
ADJUST ALIGNMENT OF PATH-BENDING MIRROR TO CONVEX MIRROR
ST2
ADJUST ALIGNMENT OF LENS-HOLDING FLANGE BY HOLED REFLECTOR
ST3
PLACE REFRACTING OPTICAL LENS ON LENS-HOLDING FLANGE
ST4
PROJECT IMAGE OF MICRO-MIRROR DEVICE ONTO JIG SCREEN
ST5
FINISH

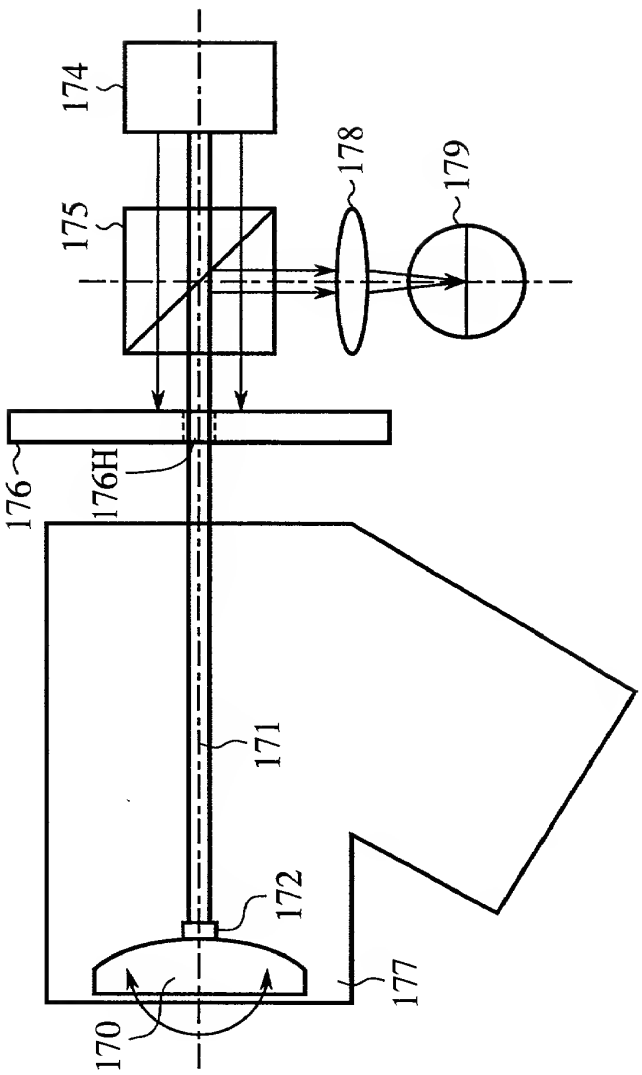


FIG.84A

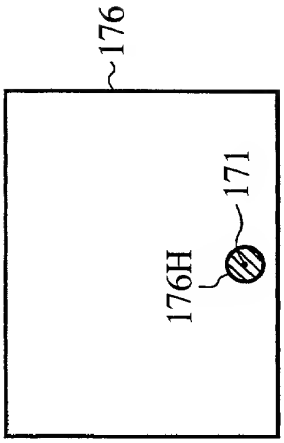


FIG.84B

FIG.85

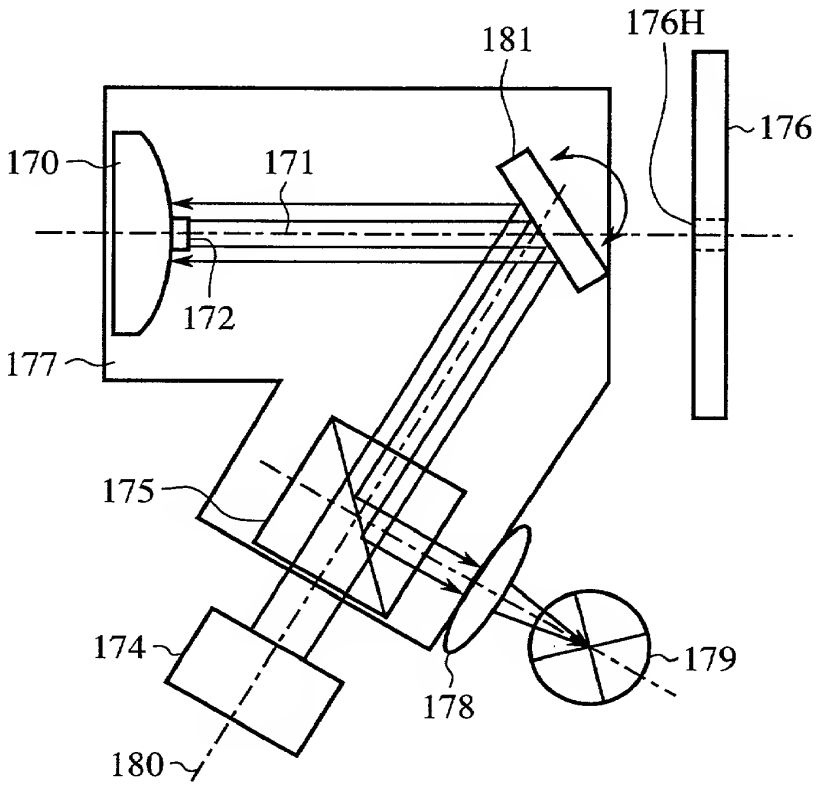


FIG.86A

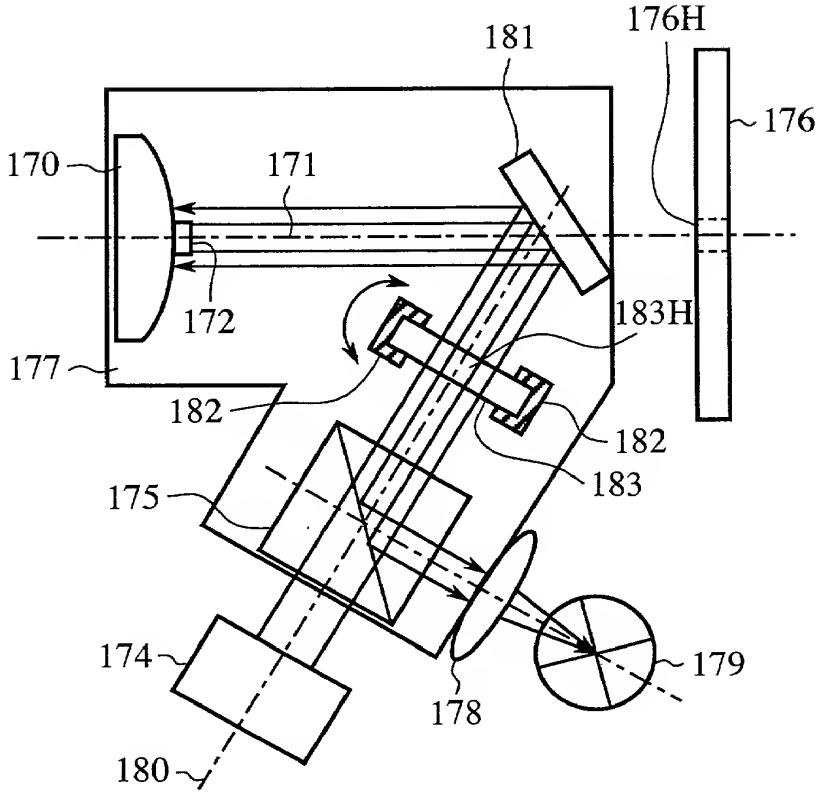


FIG.86B

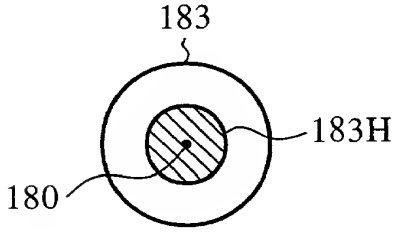


FIG.87

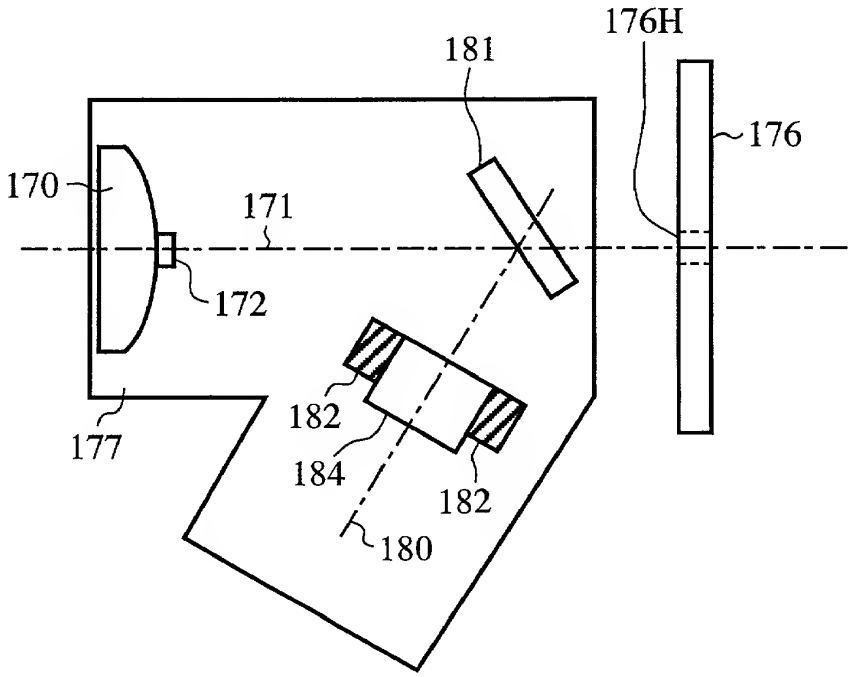

176H
181
176
170
171
172
182
177
184
182
180

FIG.88

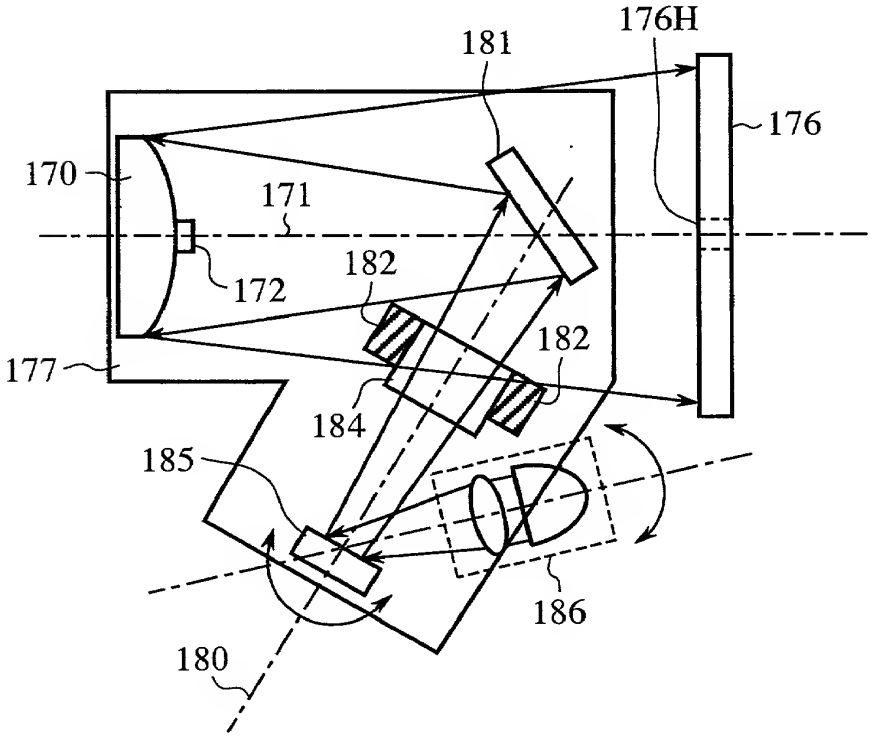

176H
181
176
170
171
172
182
182
177
184
185
186
180

FIG.89

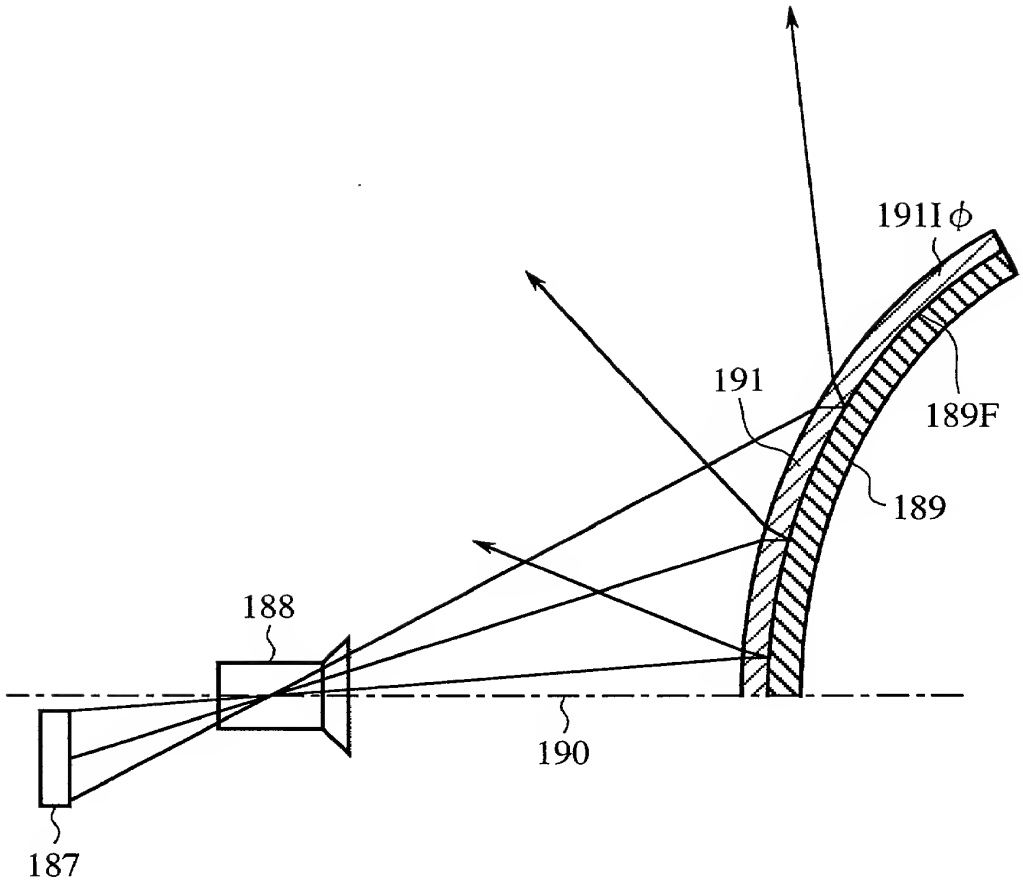


FIG.90A

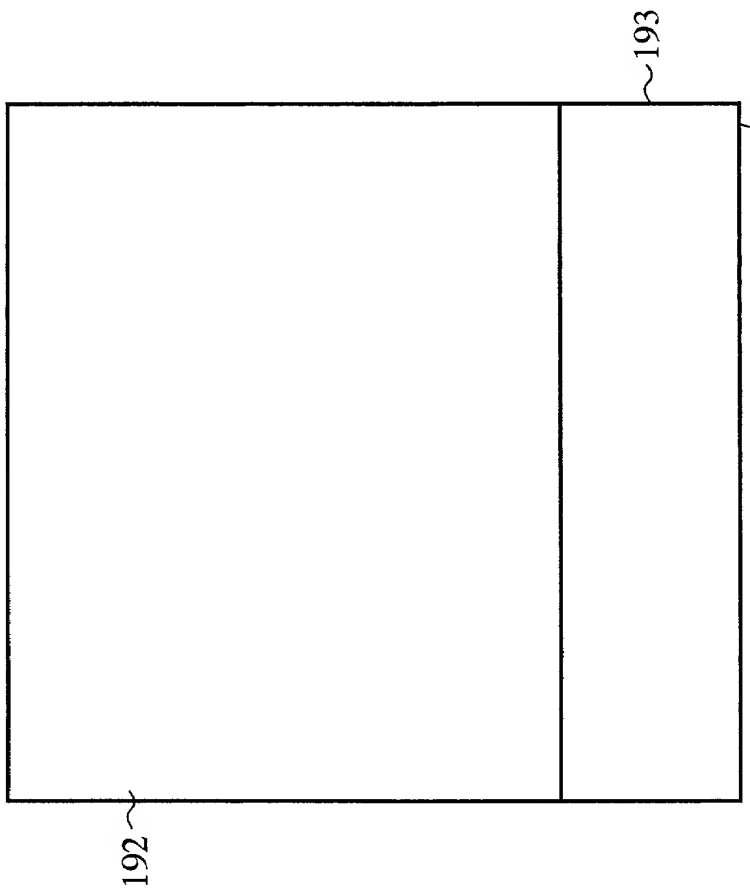


FIG.90B

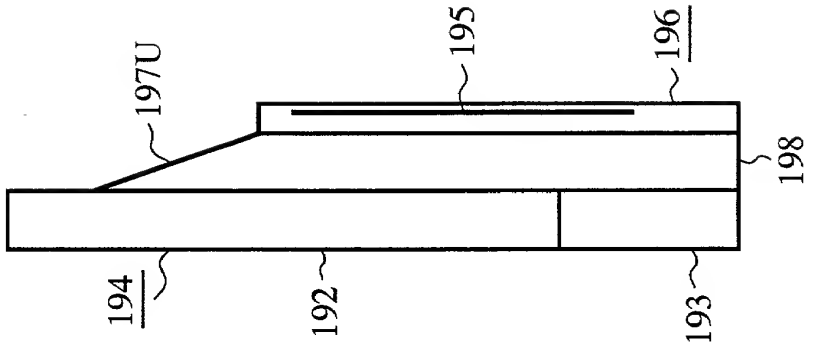


FIG.90C

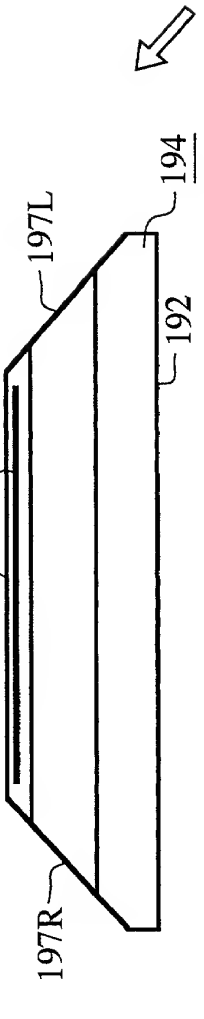


FIG.91A

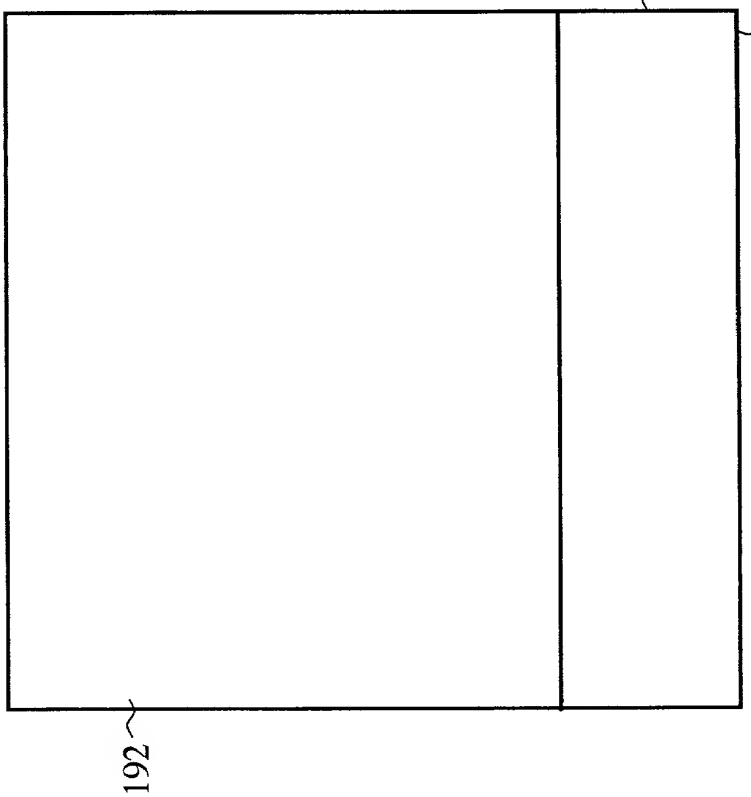


FIG.91B

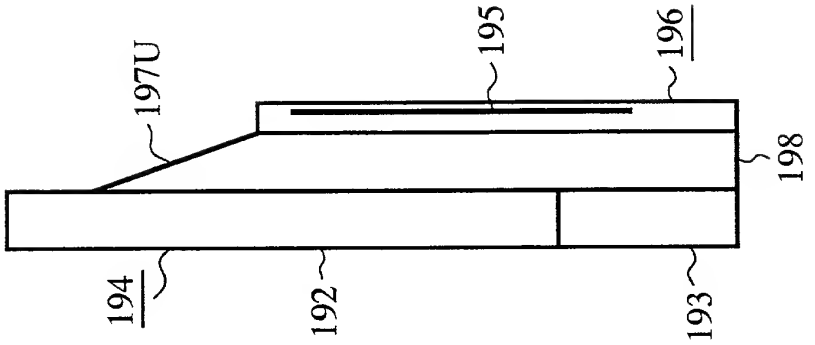
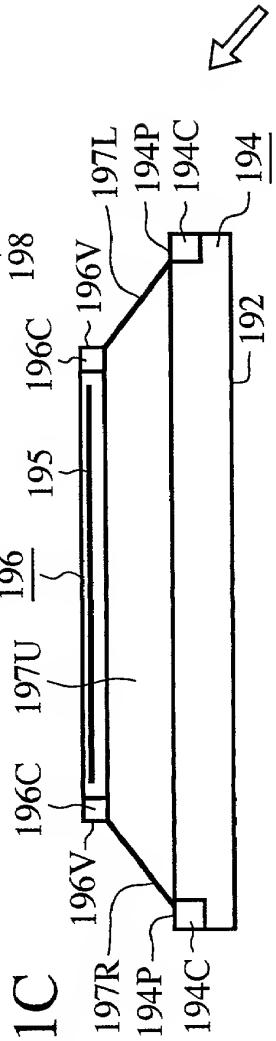


FIG.91C



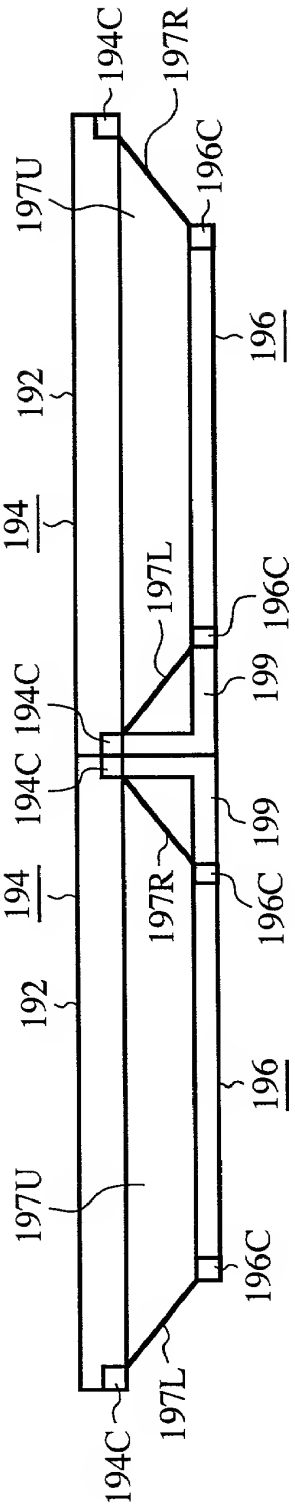


FIG.92A

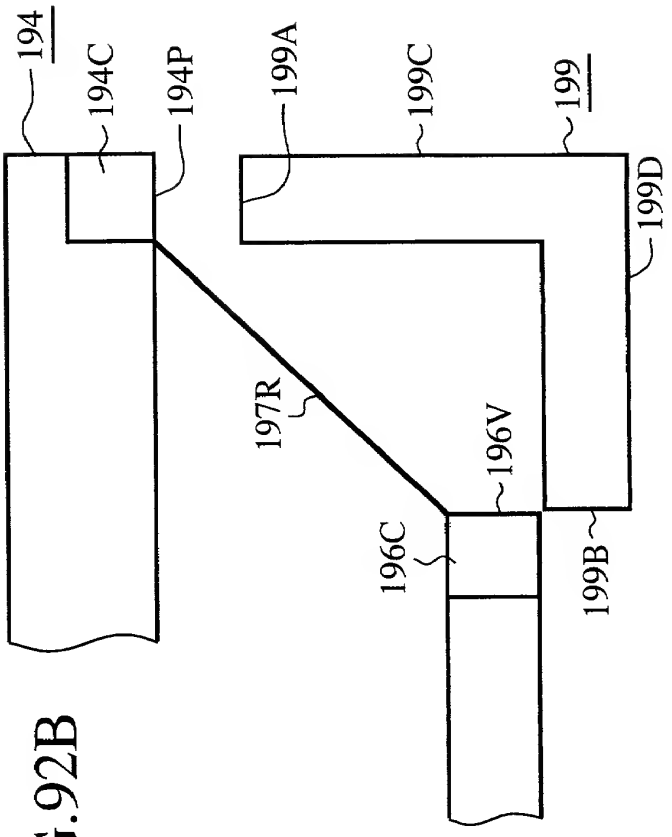


FIG.92B

FIG.93

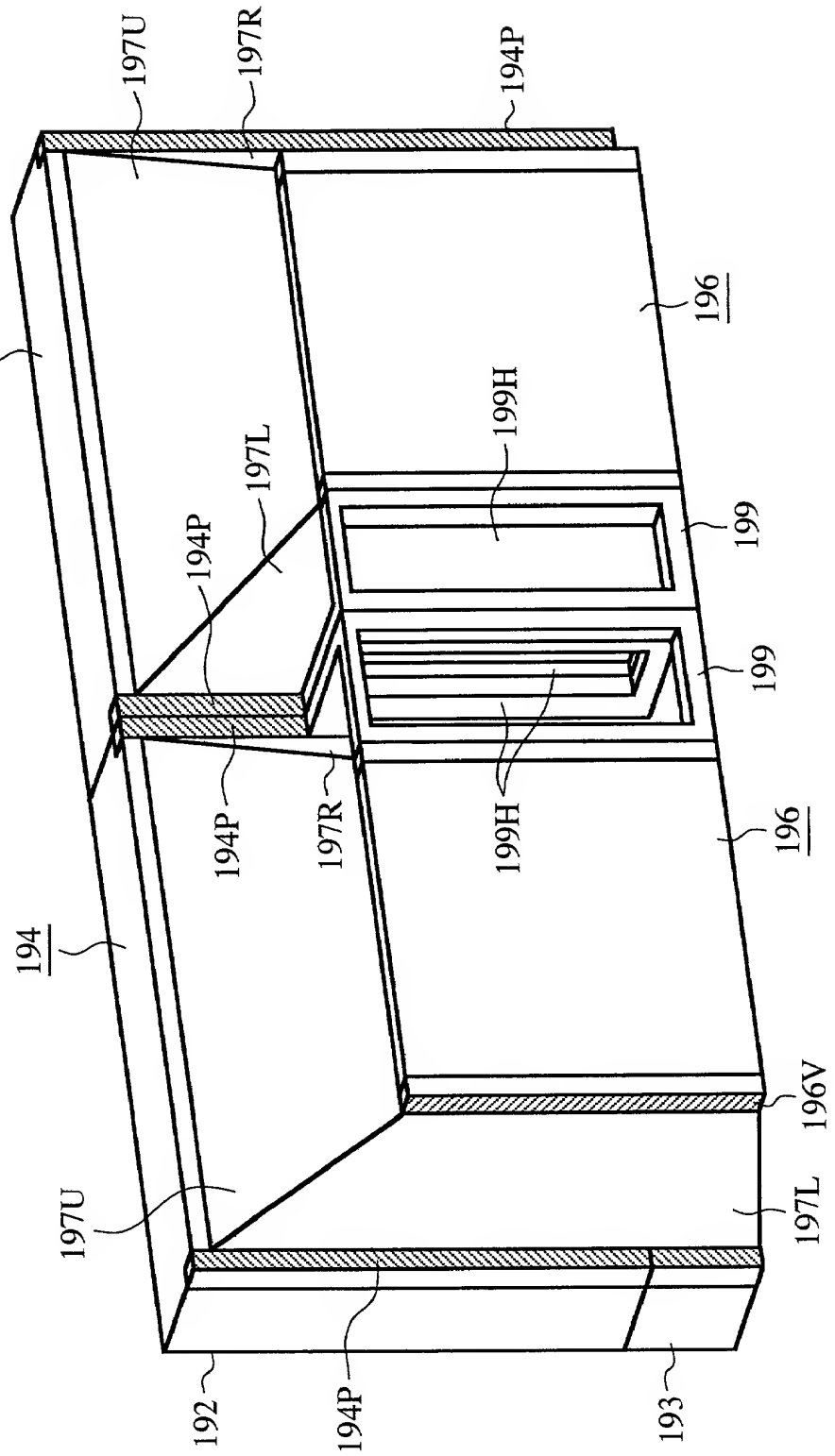

197U
197R
194P
194
196
199H
197L
194P
199
199
194P
197R
199H
196
194
196V
197U
197L
192
194P
193

FIG.94A

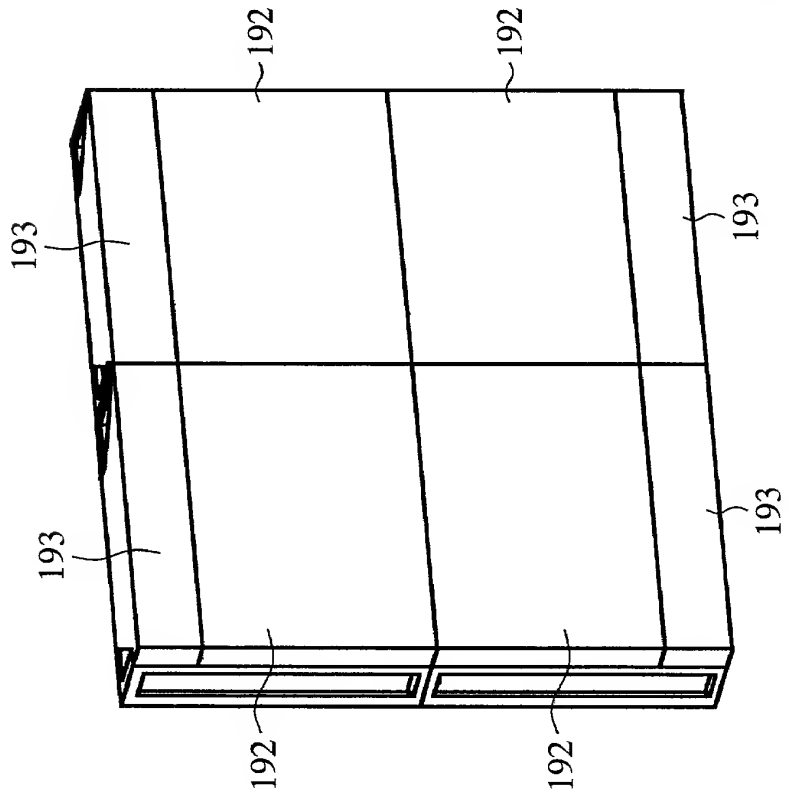


FIG.94B

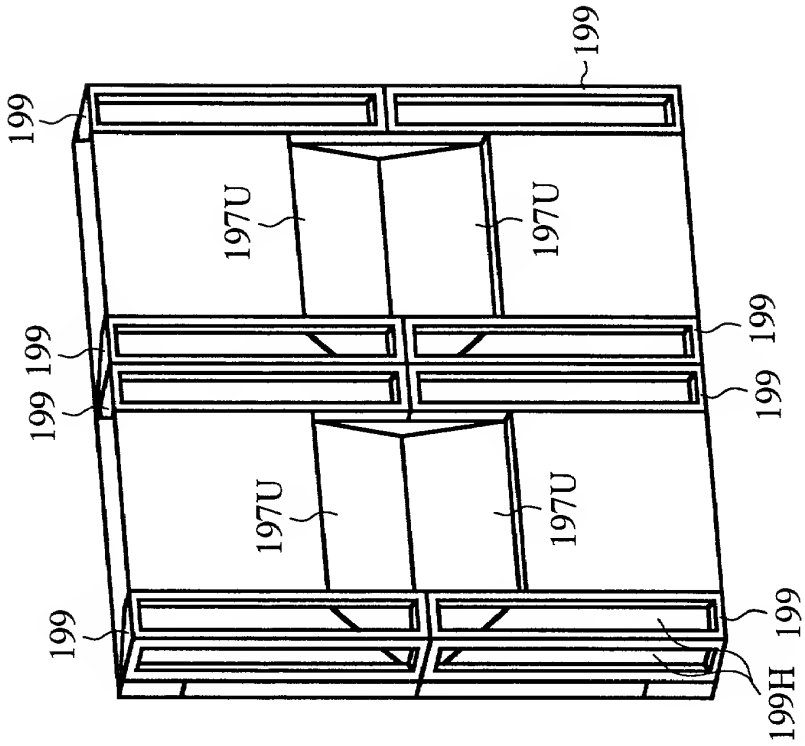


FIG.95

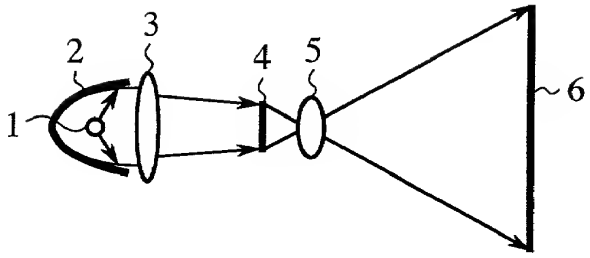


FIG.96